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THE DISTRIBUTION OF ELECTRICAL ENERGY FOR LIGHTING.

When the incandescent lamp was first developed it was recognized that the best method of supplying energy for its use was on a parallel or multiple arc system. The higher the pressure at which such lamps can be supplied the less, of course, is the necessary capital outlay for copper and the greater therefore the distance to which current can be supplied from the centre of generation. It was early discovered that it was impracticable to make lamps for a pressure much over 110 volts, and the same limitation seems to apply to the present day, the efficiency of lamps for higher voltages being necessarily lower than those for this standard. Distribution for distances over 1000 feet or so is out of the question at this low pressure, and many different methods have been developed for increasing the possible area of supply from any centre of generation. Most prominent of these is perhaps the Edison three-wire system, by which the voltage is doubled, reducing the amount of copper for the same loss and regulation about 65 per cent. and thereby almost doubling the radius of supply and almost quadrupling the area of supply from any point. This, however, does not enable the distribution to be carried far enough to obtain stations of sufficient size for the high economy now desired, except in the most congested districts. A five-wire system on the same plan has been used somewhat, especially in Continental Europe, but is open to the objection of considerable complexity. The development of the higher tension lamp using 200 volts or over with the multiple-wire systems enables a still wider extension of the area of supply, but not sufficient for the demand of the central station manager of the present day, who wishes to be able to supply districts covering many square miles. Alternating current systems enable the pressure of high tension generators and lines to be readily stepped down in simple apparatus, and have been much used, especially in sparsely settled districts, but have suffered severely through the carelessness of their managers in the installation of transforming systems with an outrageously low all-day efficiency, which has brought them into a disfavor they do not deserve.

In the serial article in another column on "London Electric Light Stations" there is described what is known as the Oxford system of distribution. This system, which has never come into use in this country, consists fundamentally of a high tension (generally 1000 volts) direct current constant potential generating and transmitting system combined with sub-station motor generators, used as direct current step-down transformers, and a low tension distributing system. This method of working is the exact direct current analogue of the ordinary alternating current system with high tension generators and lines, transformers and low tension distributing networks. A comparison of the relative advantages and disadvantages of the two is interesting. The most radical difference between them is the necessity in the one for transformers with moving parts, involving much greater fixed losses than stationary transformers of the same capacity for alternating currents and also requiring attendance. The direct current system allows the use of storage batteries with no extra machinery, and also allows the use of direct current motors, an advantage now rapidly diminishing with the improvements being made on the alternating current motor.

In this country, where the advantages of centralized generation were not fully appreciated quite as soon as in England, the advocates of low tension direct current distribution, known in this country as the Edison system, have clung to the use of 220 volts as a maximum with separate generating stations, until the development of multiphase alternating systems has allowed the installation of alternating machinery for power distribution from a central generating station to step-down sub-stations; so that any such system as this direct current high tension will probably never come into use in America. The multiphase alternating generator is vastly superior to the direct current high tension generator, as the difficulties of insulation for the same pressure are much more easily overcome, or, in other words, the pressure can be carried much higher on the multiphase generator than on the direct current, with no greater difficulty. The step-down transforming apparatus from multiphase high tension to direct current low tension is also slightly superior to that from direct current high tension to low tension, there being no high tension commutators necessary. Whether it would not be better to avoid the commutator entirely and make the whole system alternating is now a debatable question. If it were not for the many direct current motors which would have to be replaced it is probable that this would be done in the several notable instances where high tension alternating current centralized supply is being added to existing low tension direct current systems.

TOO MANY TRANSFORMATIONS.

The standard high tension alternating pressures of 1000 or 2000 volts for distributing networks being unsuitable for long-distance transmission work, which is now coming into such general use for the utilization of water powers or for the further centralization of generating stations, there has developed in many instances a double transformation of alternating currents between the high tension lines and the consumers' devices. In the first installment of the article on "London Electric Light Stations" the Deptford plant is described, in which 10,000 volts is used on the lines, stepped down to 2400 volts in sub-stations, and further stepped down to a suitable lamp voltage at or near the point of consumption. At Niagara the same condition prevails, 11,000 volts now being used on the Niagara-Buffalo line and double that pressure contemplated, the distribution in Buffalo being at about 2000 volts, which is again stepped down to 100 or 200 volts. A further aggravation of this difficulty is involved by the use of motors with which 100 volts is considered too low a pressure and 1000 too high, and the mean is struck at about 400 or 500. The National Electrical Code tends to perpetuate this unscientific practice by specifying for extra high potential systems (over 3000 volts) prohibitory precautions on the secondary with the remark: "It is not deemed advisable to permit a primary current with a potential of over 3000 volts without an intermediate step-down transformer." It is hard to see just how much this intermediate transformation increases the safety of the installation. If the lamp system is provided with an efficient earthing device, or better, with a solid ground connection, it is impossible to get a dangerous voltage between the fixtures and ground, whether there is one transformer used or two. If no such earthing device is used the leakage between the intermediate lines and the low pressure lines is likely to be as dangerous as between the high pressure and low pressure direct. A far more efficient insulating device than an intermediate system is the use of a grounded metallic shield between the windings of the high pressure and low pressure coils in the transformers.

By all means let us avoid the multiplication of standard pressures, especially to such an extent that they become no standards at all; 100, 200, 500, 1000, 2000, 5000 and 10,000 might be called the present standards, with plenty of rivals between them for the honors.

THE SUSPENSION OF RAILWAY MOTORS.

There has been of late much discussion in the technical press concerning the relative advantages and disadvantages of various types of motor suspension, with, in many instances, a notable lack of appreciation of the real principles involved. In general, of course, a motor should be spring suspended, the one and only object of this being to prevent the hammer-like effect of a rigidly mounted mass on the irregularities of the rail surface.

In general, motor suspensions may be divided into four classes. The first in point of development was a suspension rigidly borne on the main wheel axle at one end and spring supported from the truck at the other end. A modification of this is the removal of the spring support from the end furthest removed from the main axle to some intermediate point at or near the centre of gravity of the motor. Another form, ingeniously developed to avoid rival patent claims, comprises a rigid mounting on the truck at the distant end with a spring suspension at the end of the motor frame over the wheel axle. This, of course, requires a separate link to maintain the proper distance for the gears between the main axle and the armature shaft. Still another form mounts the frame at both ends on springs and provides a link for the same purpose.

The object to be attained, of course, in any suspension is to avoid so far as possible the transmission of shocks from the wheel rim to the motor. In other words, the motor should roll along so far as possible in an undisturbed straight line, subject to neither abrupt vertical deviation nor rotations about any point whatever, no matter what the irregularities of the track may be. There has been an odd misconception of the value of the side bar suspension, whereby the motor can be suspended at or near its centre of gravity, removing any dead weight from the rigid connection to the main axle. It is argued that this brings the weight of the motor on to a spring suspension and thereby removes any pounding effect of the motor, and the queer corollary is drawn that if the spring suspension is moved still further toward the main axle, and the motor frame thereby made to bear upward against the axle with a force equal to the weight of the axle and wheels, the latter will be spring suspended. In the explanation of this "lifting yourself up by your boot straps" action the fact is forgotten that the blow is purely an inertia effect, and it is obvious that no matter what the upward pressure of the motor frame may be, when the wheels strike a high joint they have to jump up abruptly; in other words, their inertia has to be suddenly overcome, giving a severe blow under any circumstances.

Any abrupt rise or fall of the main axle also abruptly disturbs the motor with any suspension whereby the frame is rigidly attached to the axle, no matter where the spring support is placed. The motor is suddenly turned about some centre of rotation, this sudden twisting giving a blow on the track entirely dependent on the moment of inertia of the motor about the centre of rotation. This centre of rotation is changed by a change of the point of suspension, but in any case the effect is comparable with the direct vertical blow of the whole motor rigidly supported. With the motor entirely spring supported at two points, and only connected by a floating link to maintain proper axial distance, this effect vanishes and the motor acts as a hammer only in so far as the spring may lack perfect elasticity, thereby benefiting greatly both the track and the motor.

Products of Chemistry.

The action of the anhydride of orthosulphobenzoic acid on dimethyl and on diethylaniline forms dimethylanilinesulphonphthaleïn and diethylanilinesulphonphthaleïn.

London Electric Light Stations—II.

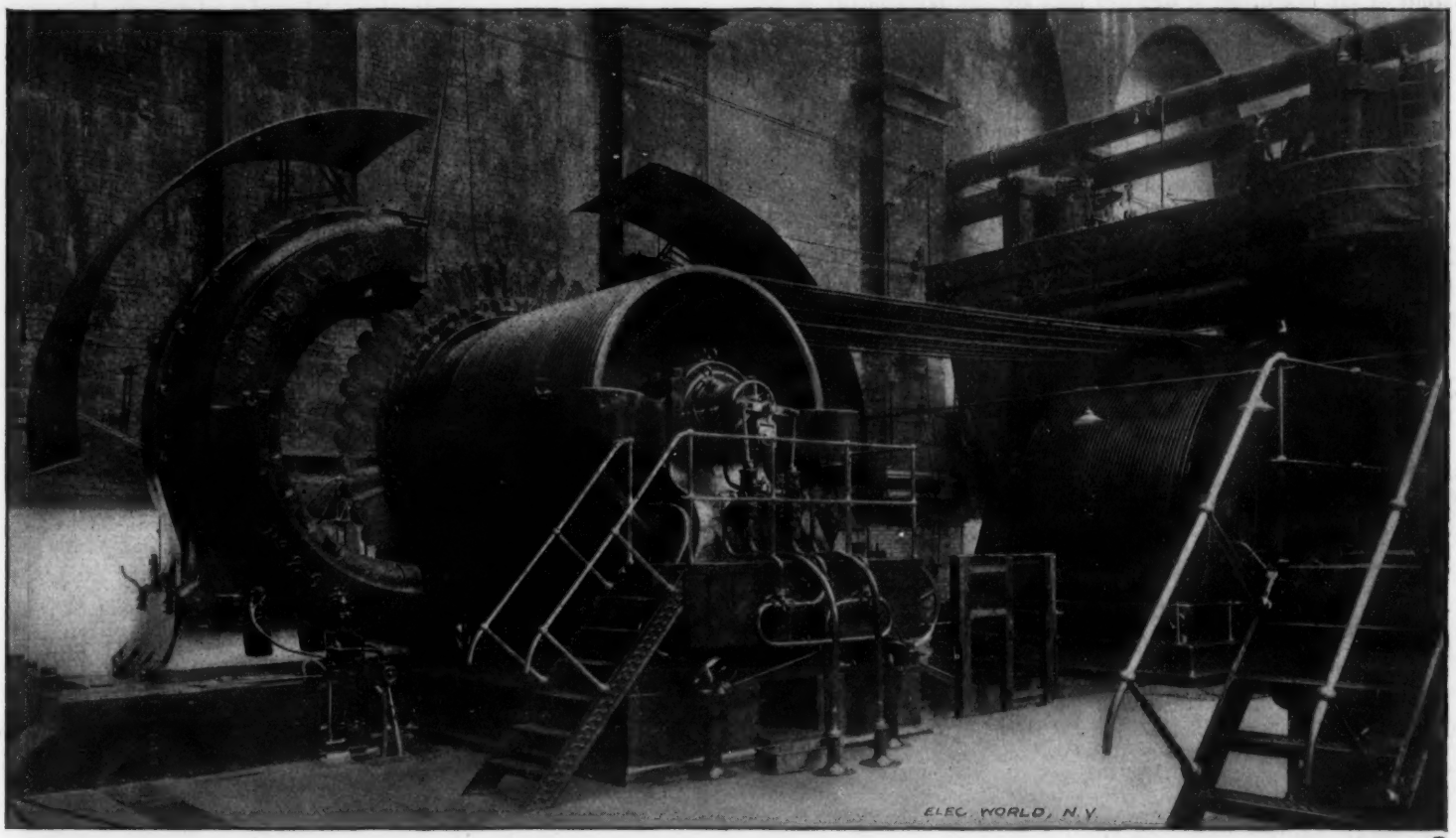
BY HERBERT C. GUNTON.

THE ST. PANCRAS VESTRY SYSTEM.

THE electric supply system of the St. Pancras vestry affords an excellent illustration of the development of a low tension system. This was the first vestry to undertake electric lighting, and was also the pioneer in street lighting. Provisional orders were obtained as early as 1883; private supply was commenced in November, and arc lighting in December, 1891. The total area of supply at the present time is about 2672 statute acres, with a population roughly estimated at 250,000. A continuous current three-wire system was originally adopted with 220 volts across the outside wires, but as the demand for current and the distance between the extreme points of the area of supply increased extensions on the five-wire system were introduced. The introduction of 220-volt lamps has, however, caused a further modification in the method of distribution, which is now carried out entirely on the three-wire system with 440 volts across the outers. There are two generating stations which work in conjunction with each other, and also with two accumulator and two balancing transformer sub-stations.

Before describing the method of working, it will be well to give a short description of the two generating stations. The old station, situated near Regent's Park, is rather remarkable for the multiplicity of its separate generating sets, affording a striking contrast to the modern and more economical practice of installing large units. There are in all fourteen Willans triple-expansion engines. Nine of these drive Johnson & Phillips six-pole generators, each of 80-kw capacity, at 110 volts, three drive two-pole generators, by Messrs. Latimer, Clarke & Muirhead, each of 80-kw capacity, at 220 volts, while the remaining two engines drive the arc lighters, which give 90 amperes, at 580 volts pressure. The steam consumption for the sets consisting of the Willans triple-expansion engines and Johnson & Phillips 80-kw dynamos was found to be as low as 18.65 pounds per electrical hp-hour, working condensing with the fields separately excited. Steam is at present supplied at 170 pounds pressure by eight Babcock & Wilcox boilers. The Regent's Park station is about to undergo considerable and important extensions which ought to greatly increase the economical working of the plant. Two 780-hp sets will be installed, superheaters will be added to the boilers and evaporative condensers will be erected.

The new station in King's Road contains plant of an entirely different character, designed to better cope with the extensions of the the system. As it represents more modern practice in low-tension work a detailed description will be given. The steam-raising plant consists of five Lancashire boilers, each capable of evaporating 5500 pounds of water per hour. The first three of these boilers were installed by Messrs. Easton, Anderson and Goolden, and were specially mounted and designed for working either with coal as a fuel, or in conjunction with refuse destructor cells, the gases from which were passed through and under the boiler from the back end and away to the stack through a cast iron downtake at the front end of the boiler. Working in conjunction with the destructor is now entirely given up. An enormous quantity of dust was brought over from the cells, and it is found to be far more satisfactory to stoke the boilers in the usual way with coal. The feed, for which town water is used, before being pumped through the economizer into the boilers is softened in a Doulton water softening apparatus. The hard water and lime water in the proportion of 10 to 1 are passed into a settling tank and afterward through a mechanical filter. Steam is supplied to the engine room at a pressure of 125 pounds through a cross-connected wrought-iron main steam ring of 7 inches diameter provided with copper bends.



ROPE-DRIVEN ALTERNATOR, 1500 HORSE-POWER. DEPTFORD.

In the engine room there are six sets of generating machinery. There were originally installed three double units, each consisting of a 200-hp Bellis high-speed compound two-crank engine driving two Crompton dynamos, direct coupled one at each end of the engine shaft, and carried on extensions of the engine bed plate. The output of each dynamo is 550 amperes at 120 volts at 350 r. p. m. This arrangement of plant, although fairly compact, cannot be compared with regard to economy of floor space with the Edison three-wire units with overhung dynamos. Another double set, arranged in the same manner as the above, consists of a 260-hp Peache three-crank tandem compound engine, by Messrs. Davey Paxman & Co., driving direct two Crompton dynamos, which

supply current at 220 volts. The following figures were recently obtained from this combined set:

	Full Load.	Half Load.
Steam pressure in chest	105.9	56.0
Vacuum	25.05	26.6
Revolutions per minute	377	375.7
Average output kilowatts	155	82.12
Estimated horse-power	207.5	110
Indicated horse-power	252.0	141.6
Combined efficiency	82.5	75
Steam pounds per indicated horse-power hour	18.5	19.5
Steam pounds per estimated horse-power	22.5	25
Steam pounds per kilowatt hour	30.2	35

In addition to the above there are two Willans HHH engines, each of which drives direct a single Crompton dynamo supplying current at 220 volts. The condensing plant includes three Ledward ejector condensers and one evaporating condenser, and water is circulated by means of three sets of Gwynne centrifugal pumps driven by Crompton series-wound motors. Each pump can deliver 25,000 gallons per hour against a head of 45 feet, or 20,000 gallons per hour to a height of 25 feet, being provided with means for varying the strength of the fields. They either deliver direct into a 6000-gallon storage tank or over a cooling apparatus. A combined air and circulating pump is provided for the evaporative condenser.

The switchboard was originally designed for a five-wire system and is divided into two halves, one for the machines and the other for the circuits. The mains from each machine are brought up to a separate panel and are connected to vertical bars placed on the front of the board, while five bus bars are run horizontally at the back of the board. Thus any machine can be connected to any circuit. The machines and feeders are provided with the usual measuring instruments and switches. A special feature about the regulation of the dynamo fields is the fact that the resistances are placed underneath the engine room floor and are operated by vertical spindles placed in a convenient position in front of the switchboard. In the case of the two Willans sets the field regulation is entirely dispensed with, the pressure being controlled at the engine governor.

Returning now to the operation of the whole system it will be necessary to say a few words concerning the balancing transformers. Each set consists of two double machines coupled together, that is, there are four commutators which are connected up in series. These machines greatly add to the flexibility of the system, and are used in the following different ways: When the distribution of current from the King's Road station was carried out by five wires the balancing transformers were used to distribute the pressure equally between the four circuits, as indicated diagrammatically in A of the accompanying diagram, while they are now used for the same purpose with three wires being connected up as shown in B. The current from the Regent's Park station is boosted up for charging the cells by means of one of these sets placed in each battery sub-station, C, or the King's Road station can be shut down after 12 P. M. and the 440-volt network supplied from the outers of one of the transformer sets, the inners of which are run as motors from the Regent's Park 220-volt network, as shown at D. The maximum output of the two stations is about 8000 amperes, 3000 of which is supplied within a radius of a quarter of a mile from the Regent's Park station. Current is used for power to the extent of about 200 horse-power. The street lighting in St. Pancras is being developed in a very interesting manner. There were originally ninety 32-hour Brockie-Pell arc lamps, and ninety-seven Crompton-Pochin lamps additional are now being erected. In all the main thoroughfares two distinct systems are in vogue in order to obtain immunity from complete breakdown, half the lamps being supplied from the high tension, while alternate lamps are supplied from the

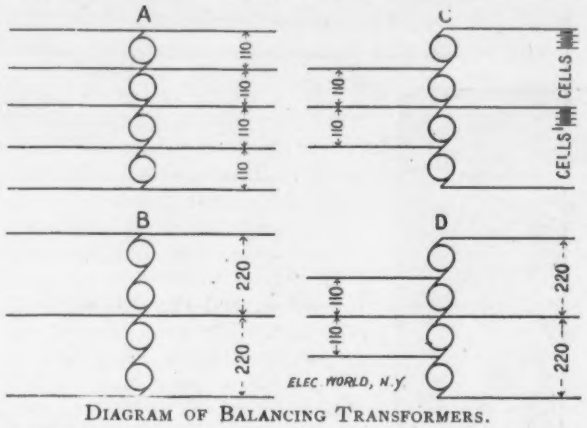
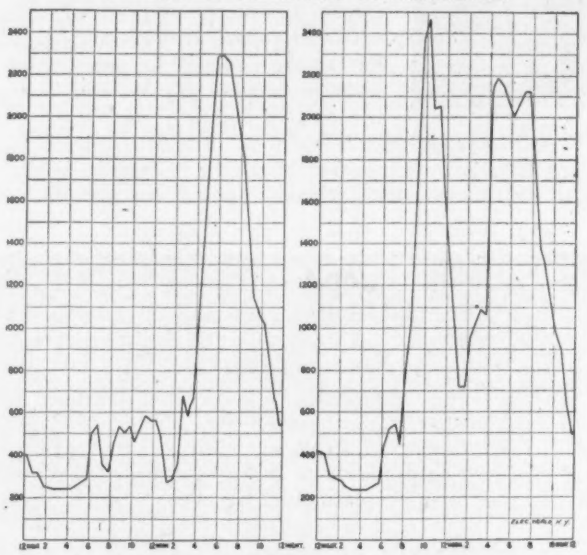
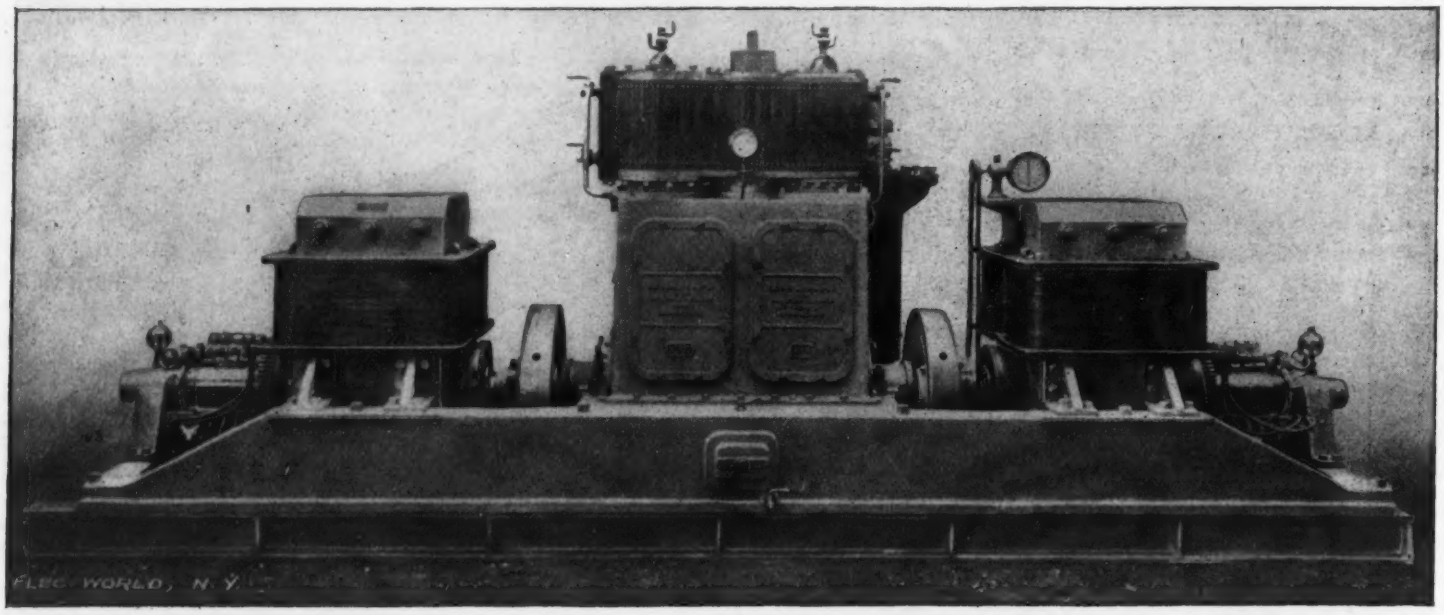


Diagram of Balancing Transformers.

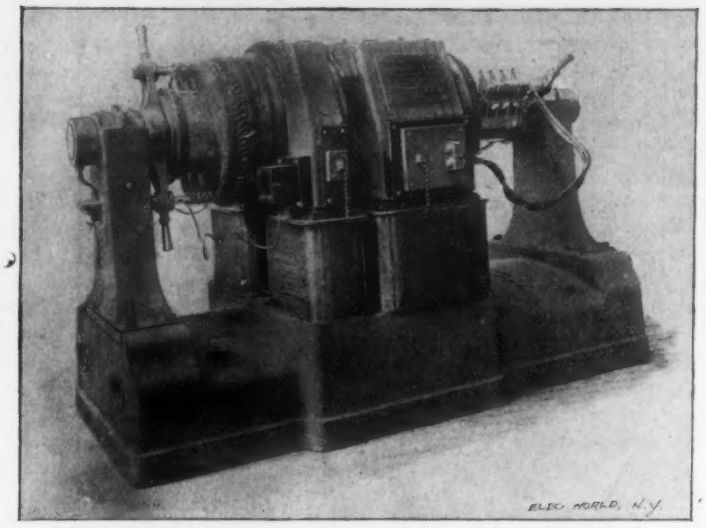


Load Diagrams. Regent's Park Station.



Bellis-Crompton Three-Wire Set. King's Road Station.

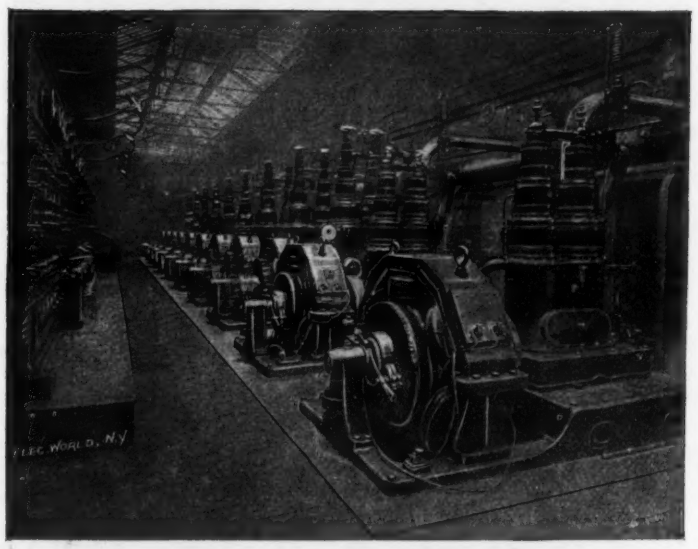
low-tension mains. The distance between lamps is from 90 to 100 yards. For the lighting of the side streets, Mr. Baynes, the managing engineer, has proposed lengthening the existing gas lamp-posts, as shown in the initial. The upper portion of the post is removed, and a curved extension piece, to carry the arc lamp, is added, the joint being made by a spigot and socket run up with



VARIABLE RATIO CONTINUOUS-CURRENT TRANSFORMER.

lead and caulked. The cost of the extension piece is about 18s., and the total cost of altering a post does not exceed 21s. Each post is fitted with a 2½-ampere Stewart enclosed arc lamp which burns without attention for 170 hours. It would not be practicable to use ordinary arcs for this purpose, as the labor required would cost too much. The load curves give a good idea of the character of the demand, the curves showing two peaks being plotted for a day when London was enveloped in a dense fog which lifted in the middle of the day and allowed the extinction of the lamps for about four hours.

The St. Pancras vestry charges 6d. per unit, with special reductions in the case of current for motive power. The price which is



GENERAL VIEW OF REGENT'S PARK STATION.

allowed for the arc lighting is 5d. per unit, this including the necessary capital with interest and depreciation, upkeep and trimming. It has been found that every arc lamp installed replaces three gas lamps, each of which would cost £3 per annum. The total cost at St. Pancras per unit sold was 3s. 5d. for 1896, the total cost being as high as 69 per cent. of the revenue.

THE OXFORD SYSTEM OF DISTRIBUTION.

Before proceeding to describe the Chelsea and Shoreditch systems it will be advisable to give a short outline of the so-called "Oxford" system of electricity distribution by continuous current transformers, adaptations of which have been used in both of the above mentioned cases, though with considerable variety of detail. It consists briefly of a generating station (which may, if necessary, be placed outside the area of supply) from which high tension continuous current, at a pressure of 1000 to 2000 volts, is transmitted through trunk mains of comparatively small section to distributing sub-stations placed at convenient points within the area of supply. These sub-stations contain motor transformers, which reduce the pressure to 100 or 200 volts, and feed on to a two or three-wire distributing network. The whole system, of which a diagrammatic scheme is shown on the following page, can be economically worked in connection with accumulators placed either at the central station (as at Shoreditch) or in one or more of the sub-stations (as at Chelsea).

The sub-station plant may either be controlled by attendants at the sub-stations themselves or may be automatically switched on and off from the central station. In the latter case the transformers are provided with series coils, which are only used during the starting up, after which the excitation is obtained from a shunt winding on the low tension side. The Electric Construction Company has recently designed a variable ratio motor transformer, which is used both at Shoreditch and Chelsea. It is possible with these machines to obtain a variation in pressure of 40 per cent. to 50 per cent. on the one side, while the E. M. F. on the other remains constant. Thus the same machine can be used for lighting direct or for charging batteries at increased voltage without being supplied with a different pressure from the central station. The method adopted is to partially separate the primary and secondary winding so that an independent control may be obtained over one of them. The armature shaft carries two cores, one main and one regulator; the former is common to both primary and secondary circuits; the latter carries one winding only, and each rotates in its own field. By varying the strength of either of these fields the total E. M. F. per revolution generated in the winding which is peculiar to that field will be correspondingly altered. Thus, if the primary circuit alone is wound over the subsidiary core and the magnetic flux through it is reduced, the speed of the machine will be raised and the E. M. F. generated in the secondary winding (still rotating in a field of constant strength) will be raised in proportion.

CHELSEA ELECTRICITY SUPPLY COMPANY.

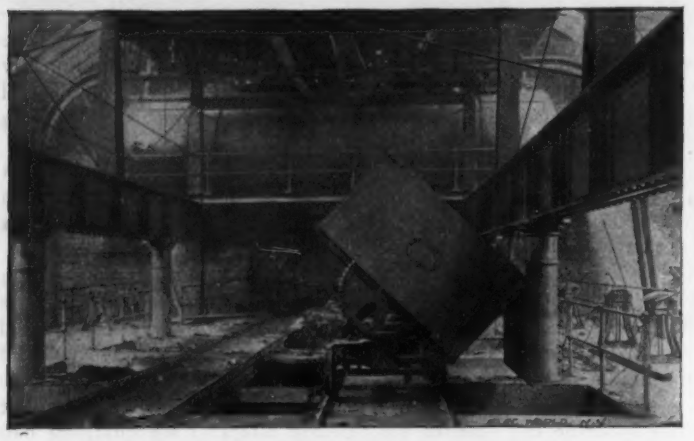
As was mentioned in the introductory remarks at the beginning of this article, the Chelsea Electricity Company was formed soon after the passing of the Electric Light Act of 1882, and current was

GENERAL VIEW OF KING'S ROAD STATION.

first supplied to customers in 1889. Extensions of an important and interesting character have lately been carried out which justify a short description. The system now adopted is similar in many respects to that since employed at Shoreditch, continuous current being generated at 1000 volts and transmitted to sub-stations, from which the distribution is carried out by a three-wire network with 200 volts across the outside wires. There are two central stations, of which one has only just been erected, and which practically forms an extension of the first, being placed quite close to it and connected with it by tie lines, the joint capacity of the two stations amounting to about 3880 horse-power. The sub-stations, five in number, each contain motor transformers and a small battery of accumulators. The cells enable the generating stations to be shut down during the

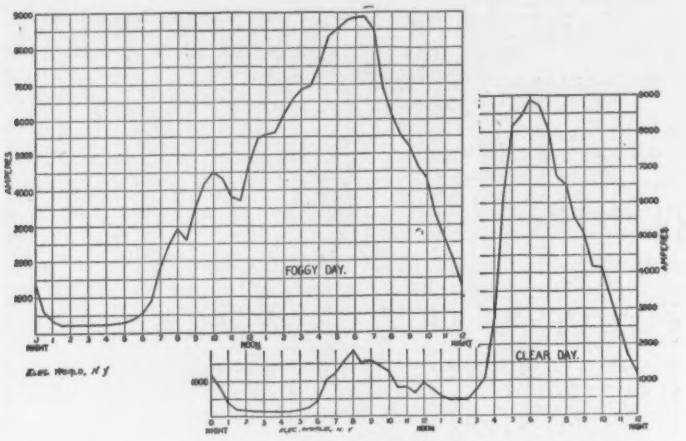
hours of light load, and for the other portion of the day they are allowed to discharge and charge continually.

The new generating station has been very carefully designed, the main idea throughout being simplicity and adaptability for future extension. The present capacity of the station is some 2900 horse-power, but this can be doubled if necessary. Coal is brought on



Refuse-Handling Car. Shoreditch.

carts to a long alley running parallel with the boiler house, where it is upset, weighed, shot down and distributed by trolley along the boiler room floor, which is below the street level. There are six Babcock & Wilcox boilers, each capable of evaporating 6000 pounds of water per hour, and two others with double drums are being erected, which are each capable of evaporating 18,000 pounds per hour. A special feature about these last two boilers lies in the fact that they are fitted at the front end of the drum with the Babcock & Wilcox feed water purifiers, the design of which is based on the principle that water containing carbonates of lime and magnesia and sulphate of lime in solution when heated to a temperature of upward of 300° F. deposits these salts, the former almost instantly, the latter more slowly. The water is sprayed into the space at the front end of the drum, and being so finely divided is heated to a high temperature by the steam through which it passes. The greater part of the salts is immediately deposited, while the remaining part, which tends to be carried over to the main drum, is skimmed off in passing through a series of baffle plates. The extension piece is fitted with blow-off cocks to clear out the accumulated deposit.



Load Diagrams. Chelsea.

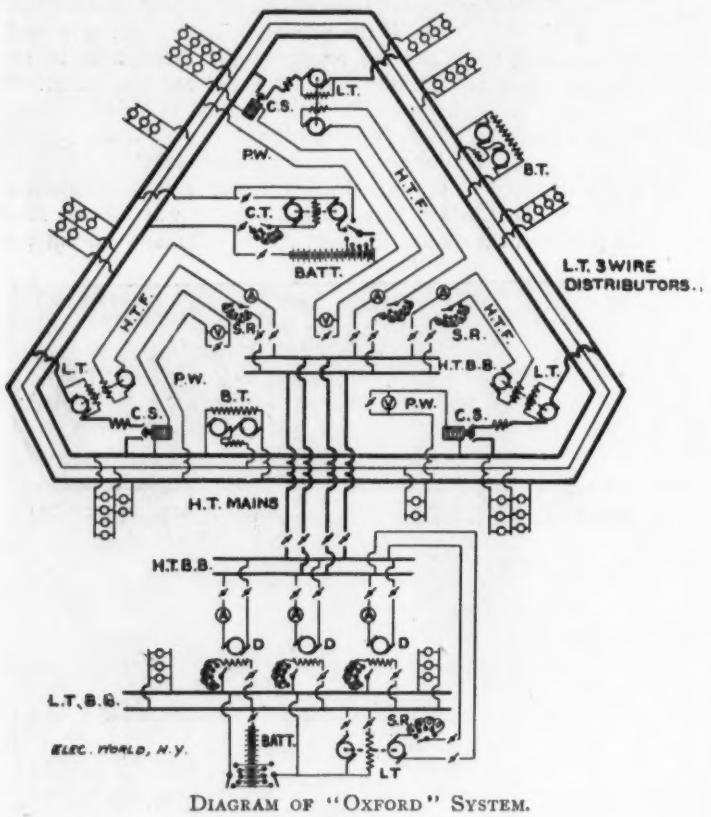
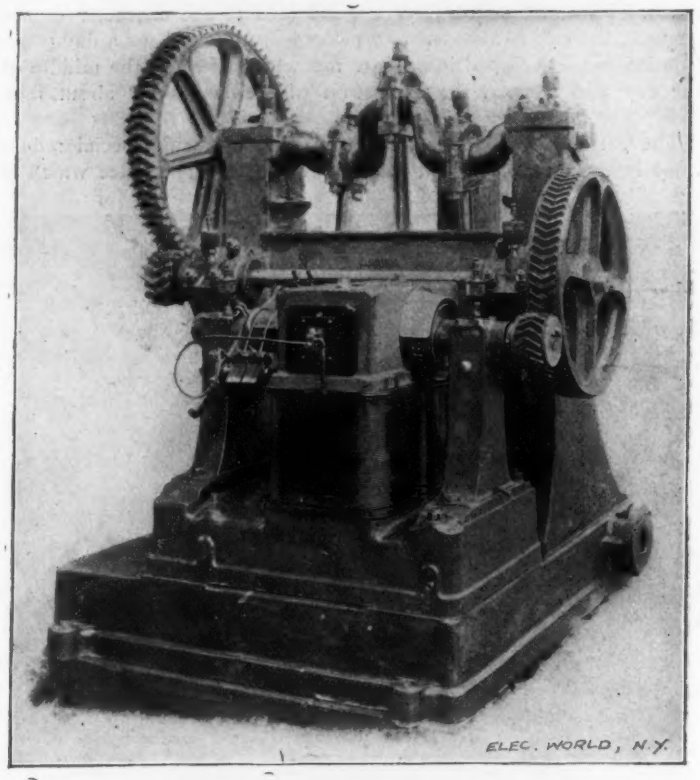


Diagram of "Oxford" System.

D.D. .. Main H.T. generators, feeding
H.T.B.B. High tension bus bar;
S.R. .. Starting switch and resistance for
L.T. .. Lighting transformer for station motors, excitation, etc.;
BATT. .. Battery for lighting and excitation when starting.
High tension trunk mains conduct the current to a controlling station, in which:
L.T.B.B. Is the low tension bus bar;
S.R. .. Starting switches and resistances;
H.T.F. .. High tension feeders to primary of
L.T. .. Lighting transformers connected across the outer wires;
P.W. .. Pilot wires, for operating
C.S. .. Controlling switches and
V. .. Voltmeters showing pressure throughout network;
C.T. .. Charging transformer for
BATT. .. Battery supplying day load;
B.T. .. Balancing and regulating transformers.



Motor-Driven Feed Pump. Chelsea.

Although at present working with injectors, the feed water (which is drawn from the town mains) will soon be dealt with by means of electrically driven pumping sets, each of which consists of a motor driving through reduction gearing a three-throw pump. The motor is specially designed to give a considerable variation of speed without undue waste in resistance, this result being obtained by having magnets of ample size with an exceptionally strong field which can be cut down by a shunt regulator. Also, the armature winding is divided into a large number of sections so that the speed may be still further varied by shifting the brushes through a large range without sparking.

The distribution of steam to the engines presents some rather special points. The ordinary form of ring main has not been adopted, but the boilers, piping and engines have been divided up into three sections of different capacities. In each section there are two main steam pipes, one running along each side of the wall between the boilers and engines, and these pipes are cross-connected. No valves are placed in these main pipes, but are provided in the branches to the boilers and engines, these stubs being very short, as the back ends of the boilers and the engines both come close to the intervening wall. In order to still further insure the supply of dry steam a drainage pocket is provided in the middle of each section. The station is worked non-condensing. There is no economizer, but the exhaust steam is passed through a feed water heater. The engine room contain six sets, consisting of Willans three-crank compound engines, coupled to dynamos, supplied by the Electric Construction Company, which are designed to give 150 amperes at 1050 volts when running at 370 r. p. m. Four similar sets of larger size are being erected, to be capable of giving 210 amperes at 1050 volts at 350 r. p. m. The foundation of these sets consists of concrete blocks, which are entirely separated from the rest of the foundation, and vibrations are accordingly kept from the building.

The field magnets of the dynamos are excited from the low-tension mains. The switchboard is of a very simple design. Each machine is fitted on its own panel with an ammeter and voltmeter, a double throw switch for paralleling, an automatic minimum cut-out, an S. P. switch, a field switch and an automatic maximum cut-out with quick break. A representative sub-station contains twelve 80-kw motor transformers provided with extra fields to obtain a variable ratio of transformation of 930 to 1030 volts on the high-tension and 100 to 130 volts on the low-tension side. The voltage is varied between these points by means of a resistance placed in the auxiliary field only. The transformers are run in parallel off the high-tension bus bars and are also in parallel on the low-tension side. There is a single starting resistance for the whole set of machines and this is worked by a long horizontal rod running along the front of the switchboard and provided with a handwheel at each panel. Each transformer is provided on a separate panel with the following instruments: On the high-tension side with an automatic minimum cut-out, an S. P. switch and an automatic maximum cut-out; on the low-tension side, with an ammeter, S. P. switch and automatic cut-out. The central panel of the board is provided with charge and discharge switches for the cells, which are of the E. P. S-K type, and capable of giving a maximum discharge of 600 amperes at 100 volts.

The Chelsea Electricity Supply Company charges 6d. per unit with sliding scale to 5d. for current for lighting purposes, and 4d. for motors, cooking and heating, this being measured through a separate meter. The motor load, up to the present time, has not been a large one, as the area of supply contains, for the most part, residential flats and shops. No street lighting has been attempted. The total cost per unit sold is about 3d., and the total costs are about half the revenue.

A Self-Exciting Alternator without Commutation.

In the issue of THE ELECTRICAL WORLD of February 5, 1898, tests of an alternator excited by a method devised by Mr. J. L. Routin were described in an article under the above title. These tests were said to have been made at the works of Messrs. Brown, Boveri & Co., when in reality they were made at the works of the Maschinenfabrik Oerlikon, Oerlikon, near Zurich, Switzerland.

The Utilization of Low Waterfalls.

According to the London "Electrical Review" a waterfall of only 2 feet has been utilized near Tewkesbury, a turbine developing 40-brake horse-power being installed and driving an electric light installation.

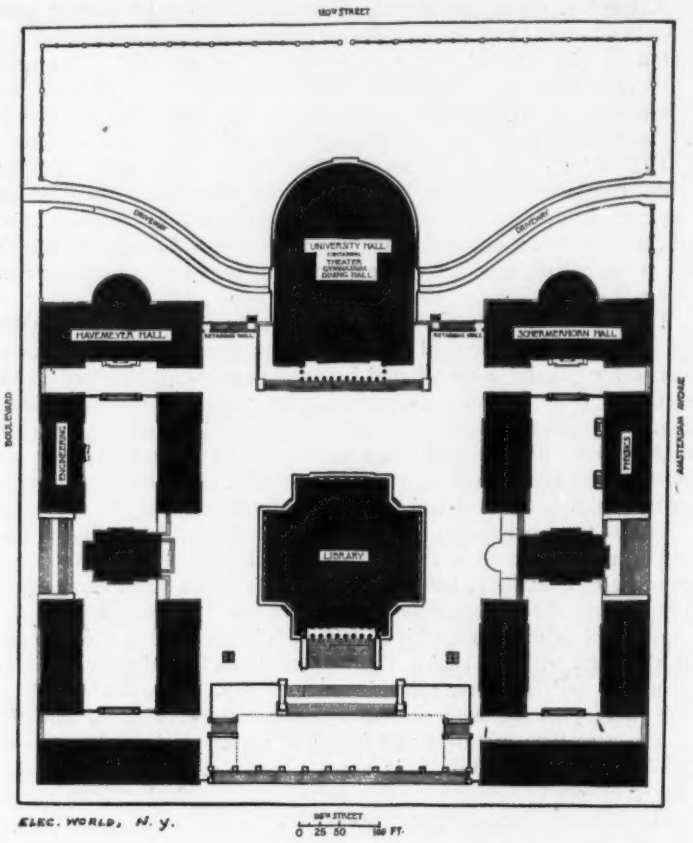
A New Cable from France to America.

The Compagnie Francaise des Cables Télégraphiques has agreed to lay a new cable from Brest to New York, in consideration of an annual subsidy of about $150,000. The cable is to be laid by the end of this month.

Electrical Engineering at Columbia University.

BY PROF. F. B. CROCKER.

The new buildings of Columbia University are located at 116th Street, between the Boulevard and Amsterdam Avenue, on the highest part of Morningside Heights, midway between Grant's Tomb and the new Episcopal Cathedral, commanding a view of the Hudson on the west and the Harlem River on the east. Thus situated in a great metropolis the University secures the manifold advantages which that fact gives it, and at the same time is sufficiently lifted above the hurry and noise of the city to have the collegiate atmosphere. This effect is still further increased by the fact that the grounds between the various buildings form a plateau about 20 feet above the level of the grounds and streets outside of the group of buildings. By this arrangement great economy of space is secured, since it gives two more floors to each of the buildings situated around the edge of the plateau, their basements and sub-basements being above the level of the surrounding grounds. The raised level between the buildings also enables tunnels to be constructed which connect the various buildings with the central power plant in the University Building. Through these tunnels all the steam and



GENERAL PLAN OF BUILDINGS.

gas pipes, as well as the electrical conductors, are carried and the cartage of coal, ashes and supplies takes place.

In this way these important practical matters are very conveniently carried on below ground, as far as the college is concerned, but at the same time above the street level. Each building is provided with an elevator, chiefly used for carrying apparatus and supplies to and from the various laboratories, lecture rooms and museums. Thus it is an easy matter to transport even heavy apparatus from any room in the university to any other room. To still further facilitate this service, the door sills are entirely omitted in most of the rooms, so that a truck can be run about the bulidings without jarring that which it carries, enabling apparatus to be arranged in the laboratory for use in the lecture rooms.

The location of the various buildings at the new site is shown in the general plan,* the magnificent library presented by President Low being the central one and easily accessible from all the others.

University Hall is the other general building, containing the power plant, gymnasium, academic theatre, etc. There are also four new buildings respectively devoted to engineering, chemistry, natural science and physics. Two old buildings will be used for the

*Only those buildings designated by names are already erected.

present by the Departments of Ancient and Modern Languages and Mathematics.

The Engineering Building, with its annex, contains the Departments of Electrical, Mechanical, Civil and Mining Engineering. Havemeyer Hall, the Chemistry Building, is the home of one of the largest and best equipped chemical schools in the world, having been designed by Prof. Charles F. Chandler and the officers of his department after a careful study of the principal colleges and technical schools in this country and abroad. The Department of Architecture is temporarily housed in the Chemistry Building, which has more than sufficient space for present needs. Schermerhorn Hall, the Natural Science Building, contains the Departments of Geology, Mineralogy, Biology, etc., and their extensive collections. The Physics Building, which also accommodates the Departments of Mechanics and Astronomy, is designed and equipped according to the most modern methods for teaching and investigating physical science.

It is a striking fact, characteristic of modern tendencies, that all four of the new buildings, beside the Library and University Buildings, which are used for general purposes, are devoted entirely to science; and three of them are especially important in their relation to electrical engineering. Hence the course in electrical engineering at Columbia, which has already gained for itself a prominent position in electrical education in this country, has been materially benefited by the removal of the university to its new site. The principal improvements consist in a considerable extension of space and equipment in the electrical engineering laboratories, as well as in those devoted to mechanical engineering, physics and chemistry.

The regular four-years' course leading to the degree of Electrical Engineer (E. E.) is designed for the education of professional electrical engineers who intend to devote themselves to the practice of this profession, either as teachers in colleges and scientific schools, or as engineers, managers, or experts in manufacturing or other industrial enterprises.

The course of instruction includes not only all important branches of theoretical and applied electricity, but also the other collateral sciences which have been found by experience to be required by the electrical engineer, such as mathematics, physics, chemistry, drawing, analytical mechanics, mechanical engineering, including a thorough course in steam and other engines, as well as transmissive machinery and shop work; general engineering, including construction in masonry, iron, steel and wood, also forms part of the course.

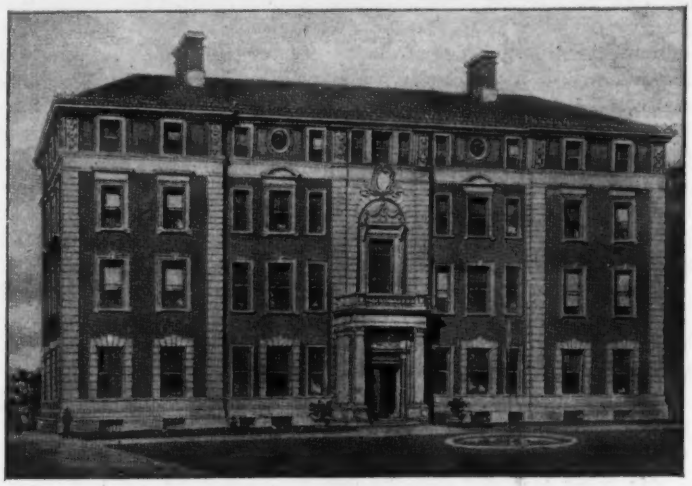
Hence the graduate in the course in electrical engineering is provided not only with a thorough knowledge of the principles and practice of electricity, but also with such a broad and liberal education in the allied sciences as will prepare him for every demand that is likely to be made upon him in after life in connection with his profession, and will also enable him to become an investigator. The instruction is by lecture, recitation, laboratory, workshop and drawing-room practice, with periodical examinations. Special attention is given to new methods and forms of apparatus in order that the student may be brought fully abreast of the rapid progress of electrical science and practice. Frequent visits are made to the numerous electrical factories, stations and other establishments in and about New York.

EQUIPMENT.

The offices, laboratories, lecture and other rooms of the Electrical Engineering Department are in the south end of the Engineering Building. In the sub-basement are located the storage battery and photometer rooms. The former contains a battery of seventy cells, to be used for efficiency and output tests and as a source of steady potential and current. The photometer room is equipped with all necessary apparatus for determining the candle power of arc and incandescent lamps, as well as other sources of light. In the basement are situated the two machine laboratories, the larger containing the direct current machinery, while the smaller accommodates the alternating current apparatus. These are shown in cross section and plan in the accompanying illustrations. In the former, a 50-hp high-speed steam engine drives two lines of shafting, carrying pulleys controlled by friction clutches, to which the various machines are belted. The arrangement of the engine and shaft is such that two dynamos of 30 kilowatts each can be connected to the engine, or either or both of the two machines may be used as motors to drive the line shafts, the current being obtained from the electric light and power plant of the university. In this way the breaking down of the motive power is rendered almost impossible and an excellent demonstration of the two methods of driving is made.

The various dynamos which are belted to the line shaft include examples of 115, 230 and 500-volt constant potential generators, constant current arc lighting dynamos, and other typical machines. Several types of stationary and railway motors, as well as motor-dynamos are also placed in this room. Machine and hand tools are provided in one corner of this laboratory for making and repairing apparatus, attachments, etc. Complete sets of ampere and voltmeters, speed indicators, transmission and absorption dynamometers, etc., are available for testing the various dynamos and motors. The smaller machines are mounted upon two long heavy tables, as represented in the illustrations, which brings them to a convenient height and affords space for instruments, note books, etc.

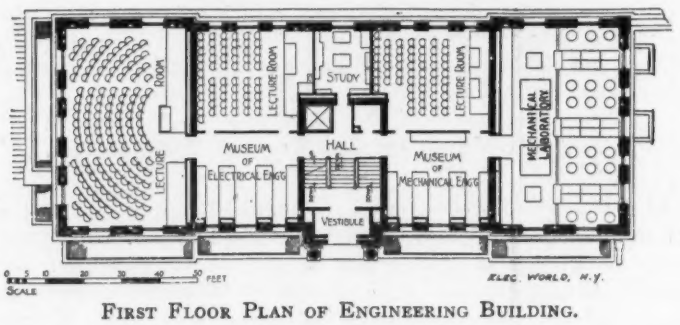
In the other machinery laboratory the alternating current apparatus is placed, including single and polyphase generators, induction and synchronous motors, as well as various types and sizes of trans-



Engineering Building.

formers. Each generator is driven by its own electric motor, enabling its speed to be independently regulated.

On the first floor, a plan of which is shown, are situated the smaller lecture room (seating seventy), ordinarily used for class work, and the larger lecture room (seating 150) for combined classes. In the Chemical Building, immediately adjoining, a still larger lecture room (seating 350) is available for meetings and public lectures. All of these rooms are provided with an ample supply of electrical energy of different forms, as well as gas, water and other facilities to enable experimental demonstrations to be conveniently and effectively performed. For example, dynamos, motors and other apparatus of practical size are shown in actual operation to



First Floor Plan of Engineering Building.

illustrate the lectures, this being made a special feature of the instruction.

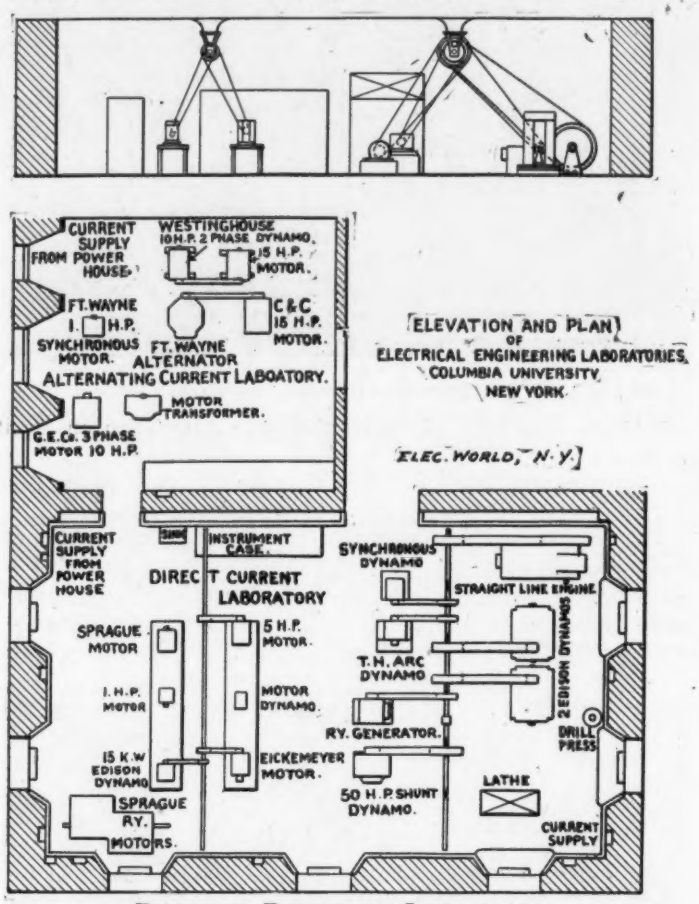
The museum contains cases for the collection of apparatus, models, materials, etc., relating to electrical engineering. This museum adjoins the lecture rooms so that its contents can be conveniently used for illustration.

On the third floor are located the large instrumental laboratory, the research room and the studies of the officers. The laboratory contains a number of tables on which the instruments are permanently set up ready for use. These include various forms of galvanometers, ampere balances, standard cells and resistances; apparatus for measuring inductance, magnetic permeability, hysteresis and leakage; laboratory standard volt and amperemeters; telegraph, telephone and electric signaling systems; thermo electric and electrical heating devices; Röntgen ray apparatus. The research room is used

for special post-graduate and thesis work, and is fitted up according to the lines of investigation that are being followed.

A most important facility is the large and reliable supply of electrical current which is afforded by the central power plant of the university. This consists of boilers having an aggregate capacity of 2000 horse-power, two low-speed engines directly connected to two dynamos of 275 horse-power each, and two high-speed engines directly connected to two dynamos of 100 horse-power each. This electrical generating plant, having a total capacity of 750 horse-power, and illustrating the latest practice in electrical engineering, furnishes current for electric lighting and for driving the motors and fans used in ventilating all of the buildings. Special conductors are also laid to convey to all the laboratories, as well as lecture rooms of the Electrical Engineering Department, an ample supply of current for experimental work.

The physical laboratories and lecture rooms occupy four floors of the Physics Building on the eastern side of the university grounds.



ELECTRICAL ENGINEERING LABORATORIES.

The building is supplied with all ordinary conveniences, including electricity for power and light, compressed air and steam. There is a vertical shaft 95 feet high, with gas, electric and water outlets at every 10 feet. In the sub-basement a constant temperature room is placed 12 feet below the surface of the ground. A platform on the roof is available for meteorological observations, an instrument room being directly below. There are two lecture rooms, a library, an apparatus room and laboratories of various kinds.

The optical rooms are furnished with spectrometers of different designs, spectroscopes, telescopes, microscopes, sets of lenses, prisms and gratings, optical benches, photometers and apparatus for calorimetry, polarized light and spectroscopy.

In the rooms devoted to electricity are galvanometers of various patterns, high and low resistance, ballistic and damped; electrometers, magnetometers, standard cells, resistances, rheostats and bridges of all types; condensers, batteries, keys, arc and incandescent lamps, amperemeters and voltmeters.

THE MECHANICAL ENGINEERING DEPARTMENT.

The Mechanical Engineering Department is located in the Engineering Building and in the annex, the space and equipment provided for it being greatly increased at the new site. This improvement is made not only on account of the importance of this branch in the electrical, civil and mining engineering courses, but also because regular courses in mechanical engineering have now been opened at Columbia for the first time, the space at the old site not having been adequate for the purpose. The department has the following equipment:

The wood-working and machine shops are located in the Teachers' College, 120th Street. For wood-working there are carpenter's benches with their kits of tools, speed lathes, saw benches and planers. For forge and blacksmith work there are forges with anvils and tools, a Bradley hammer and a Billings and Spencer drop press. For metal working there are engine lathes, with swing from 12 inches to 20 inches, planers, shapers, drill presses, a universal milling machine, universal grinding machines and a Jones & Samson turret lathe.

The testing laboratory is equipped with high-grade testing machines for tensile, transverse, torsion and compression tests. Their designs are of diverse types to give wide experience in handling, and they are fitted with the best and newest appliances for observing and recording deformations of test pieces. The Emery testing machine of 150,000 pounds capacity is used as a standard of reference.

The mechanical engineering laboratory is well supplied with dynamometers of transmission and absorption types, with oil-testing appliances, speed recorders, tachometers, weighing and measuring apparatus, anemometers, gauge testers and the like, and representative machines and mechanisms for calibration and tests of efficiency.

The steam engineering and motive power laboratory has an extensive series of indicators, with appliances for calibrating and standardizing them, test gauges, thermometers, calorimeters, pyrometers and apparatus for boiler and engine tests. A triple expansion steam engine of the Reynolds-Allis-Corliss design is arranged to work as an experimental air engine by making it a three-stage air compressor when so operated, and having all facilities for the accurate measurement of efficiencies. A full line of boiler-feed injectors is mounted for display and experiment. Steam engines of various other types, steam pumps, a 10-hp De Laval steam turbine, hot air and gas engines are at hand, and surface-condensing appliances as well. The department has also a cross-compound two-stage air compressor, the cross-compound steam end of which, with reheater, combined with the cross-compound air end with intercooler, makes a most complete example of applications of thermo-dynamic theory to practice. This laboratory is known as the Allis laboratory, in memory of the late Edward P. Allis.

The hydraulic motors laboratory contains tanks, weir-notch equipment, gauges, current meters, water meters and motors for test and experiment. Constant pressure is secured by air pressure upon the water in a closed tank, thus doing away with a stand pipe. For heavier pressures, above 100 pounds per square inch, an adjustable accumulator is used. Pumps of large capacity give the necessary quantity of water for orifice tests and other drill in hydraulic engineering. The equipment of this laboratory is presented as a gift to the university as a memorial of the late Henry R. Worthington, of New York City.

The drawing rooms are particularly well lighted and of large extent, and are fitted with the best forms of drawing tables and furniture, as well as extensive collections of patterns, models and illustrative drawings, blue prints, photographs and prints, which are useful as copies, and for training in design. Sectional models of actual machines and structural material are abundant, and for the study of projection, stone cutting and warped surfaces, there is a set of the Ollivier models, in which the elements of surfaces are represented by tense threads. In connection with the drawing academy is a room for blue printing and other solar work, and a photographic dark room.

The cabinets or museum collections of mechanical engineering exhibit models of mechanical movements, mechanisms and gearing, also material which has failed in service and under test. Specimens of apparatus and materials for practice are also included.

The Chemical Department occupies Havemeyer Hall, which is located at the northwestern corner of the group of buildings. It contains several chemical lecture rooms, fully supplied with apparatus and instruments and all modern facilities for the experimental illustration of the different lecture courses.

The museum of general inorganic and organic chemistry and of the chemical arts contains the elements and all their more important compounds, representative sets of specimens of all classes of compounds, materials and products, together with models, pictures and diagrams.

The theoretical as well as practical branches of electrical engineering are taught by Profs. F. B. Crocker and M. I. Pupin and Messrs. G. F. Sever, W. H. Freedman and S. G. F. Townsend.

Diffused Illumination.

A valuable contribution to the literature of illumination in general has been added by Prof. William Hallock, of Columbia University, in a recent issue of the "Progressive Age," from which the following points have been abstracted:

There has been ever since the world emerged from the dim light of the tallow dip a desire for more and more brilliant illumination, until of late there has arisen a demand for a mild diffused illumination, without color, without shadows, and yet with abundance of light. This light, for best effects, should come from as many directions above the line of sight as possible. In interior illumination the floors and side walls should, therefore, be dark, the ceiling as light as possible, and the illumination should come from as many sources as practicable. If one direction only is available, then the opposite wall should be kept light to give reflection. Few people realize that a "dead white" surface reflects about 80 per cent. of the light which falls upon it, and therefore that a white wall or ceiling is an excellent reflector, and in fact absorbs much less light than does any transmissive diffusion apparatus, such as ground glass globes, etc., which often absorb 40 to 60 per cent. of the light impinging upon them.

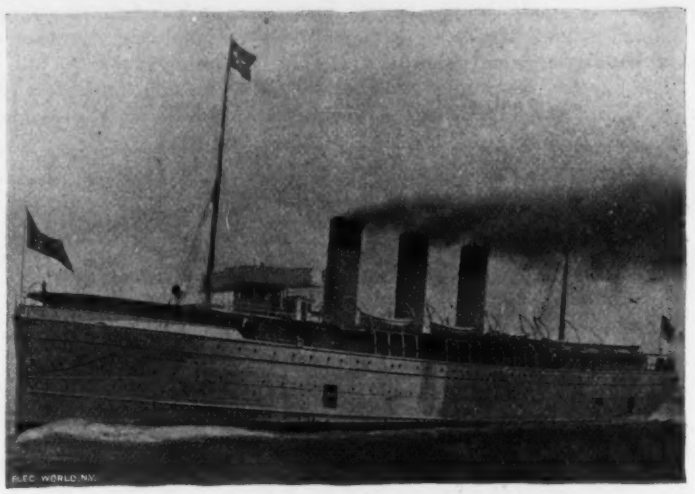
A desire for diffused illumination, for bringing out the architectural effects of the new Columbia University library, led to the following design for this purpose. A white opaque sphere, 7 feet in diameter, was suspended from the middle of the dome, 85 feet above the floor, by one-quarter-inch steel rope, the latter being entirely invisible from below. To all appearances the sphere floats in the air. This globe is a framework of wood covered with veneering and coated with a white matt surface wash, its general appearance being that of a ground glass surface. This is illuminated to an intrinsic brilliancy of from 75 to 300 foot candles by rays from eight Colt projection lanterns placed in eight equidistant corners of the four upper balconies. These lights are boxed in, so that only the projecting lens is visible. Each of them throws a disc of light 6 feet 6 inches in diameter upon the sphere. The eight discs overlap so that the whole sphere seems to glow with a pale diffused light. The effect is beautiful in the extreme. The surface seems translucent and the light seems to come from a certain depth within and to bathe the whole globe with a warm light. As the globe floats below the ceiling it is difficult to locate it; whether it is near by or a moon in the clear blue sky miles away is left to the imagination. This is not intended as a light by which to read, the tables all having reading lamps, but it is possible to read with considerable ease on the floor of the reading room by the light of the sphere alone. A crude test gives the approximate candle power as about 500, but the light is so white and so agreeable that it gives one the impression of greater power. The eight lamps take about 150 amperes, the whole lighting of the main reading room taking about 300 amperes, while the central room of the Congressional Library at Washington (about 10 per cent. larger) requires nearly 900 amperes.

The Transmission Plant of the Delta Electric Power Company.

A new plant for the transmission of power for lighting purposes has been installed at Gartridge Falls for a line running to the city of Delta, Pa., five miles away. The steam power station of the electric company in the latter place was burned in 1895, and instead of rebuilding the company decided to put in a high tension transmission system. The dam is 41 feet in height and 30 feet wide at the base, founded on rock, and in such a favorable location that the length at the top is only 120 feet. It is built up of cribwork filled with stone and arched slightly up the stream so as to bring the thrust of the water against the end abutments. A closed steel flume 7½ feet in diameter conducts the water about 100 feet to the power house. The latter is a stone structure 44 x 22 feet in size, built up from the solid rock. One pair of 24-inch McCormick turbines, made by the S. Morgan Smith Company, York, Pa., is now in place, fitted with draught tubes, which enable the wheels to be raised 20 feet above the level of the tail water, the total head on the wheels being something over 40 feet. This pair of turbines is coupled direct by a flexible coupling to a 350-kw two-phase S. K. C. inductor alternator running at 400 revolutions per minute and generating a line pressure of 5000 volts without step-up transformation. The pole line, five miles in length, carries four No. 4 wires, two for each phase. At the receiving sub-station the pressure is transformed down to 1000 volts for distribution on the existing lighting circuits, and also 450 volts for distribution on motor lines. Westinghouse Type C induction motors are used.

A Combined Convention and Excursion.

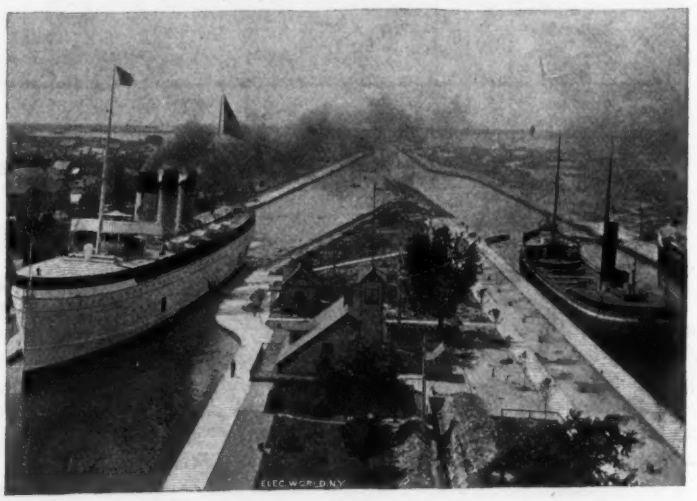
In connection with the coming meetings of the National Electric Light Association and the Northwestern Electrical Association, there is proposed an excursion which should be very attractive to those who expect to attend the meetings. The meeting of the National Electric Light Association will be held at Chicago on June 7, 8 and 9, and the Entertainment Committee of the Northwestern Electrical Association proposes to charter one of the passenger ships of the Northern Steamship Company for a trip from Chicago up Lake Michigan and Lake Superior to Duluth, Minn. The plan is



The Proposed Convention Hall.

to hold the convention of the Northwestern Association on board during the three day trip, the meetings of the other two days being held in Duluth and Superior, where the convention will adjourn, the members to return home by lake or rail as they please.

That the trip would be an enjoyable one there cannot be the slightest doubt. The ships are the most luxurious and best appointed the world over, and are built for exclusive passenger service at high speed. Stops are proposed at Sault Ste. Marie, where is located the Government ship canal, containing the largest locks in the world,



Entering the Sault Lock.

and where the outlet of Lake Superior falls 20 feet in rapids, giving an enormous available power, which is now being developed for manufacturing and electrical generation purposes. It is proposed also to stop at the twin cities of Houghton and Hancock, for a visit to the famous Calumet and Hecla mine, 13 miles distant, the largest single producer of copper in the world. At Duluth are many features of interest to electrical people, among them the enormous water power of the St. Louis River, waiting for development, many interesting traction problems, owing to the peculiar situation of the city, the interesting electrically operated bridge, described in The Electrical World of July 3, 1897, and the largest iron ore docks in the world. The expense of the entire trip, including the rail return to Chicago, should not exceed from $40 to $50 per capita. The committee of the Northwestern Electrical Association will meet before April 1 and definitely decide for or against this plan.

The Incandescent Light of Professor Nernst.

BY DR. H. LUX,
EDITOR "ZEITSCHRIFT FÜR BELEUCHTUNGSWESEN."

As long as carbon filaments are used in incandescent lights the efficiency of this lighting system will probably not be much increased. The reason for this is that carbon has almost exactly the qualities of the "black substances," as Kirchhoff denotes them. An absolutely black body absorbs radiant energy of all wave lengths, the visible rays that we call light, as well as the heat rays of longer wave length, and the ultra violet or so called chemical rays. By Kirchhoff's law a body raised to incandescence emits all the rays it is able to absorb. If an incandescent filament of carbon is used for a source of light the invisible heat rays and the ultra violet rays are emitted with the rays of light which are desired; on this account the efficiency of the incandescent light is certain to be rather small.

Numerous experiments have been tried with the aim of increasing the emission of light from incandescent filaments. Most of these experiments were based on the idea of coating the conducting filament with materials having high brilliancy at a comparatively low temperature, such as magnesia, the rare earths and so on. These experiments proved a failure for the simple reason that these materials emitted all the rays which they themselves absorb. The rays, both below and above the visible spectrum, emitted by the incandescent carbon were produced and lost as before at the cost of a low efficiency of the lamp.

The experiments of Professor Nernst were in another direction, no attempt being made to use the carbon filament, which has qualities similar to a metallic conductor of electricity. He uses the so-called conductors of second class, such as chalk, magnesia and kaolin, materials that, when cold, have an extremely high resistance to the current, so high indeed that they might be called insulators, this resistance falling greatly at high temperatures.

These materials are notable for the large proportion of visible light rays in their radiation. The lime light and the Welsbach incandescent gaslight are notable instances of the application of this principle. As Professor Nernst says in a letter, these materials have a higher emission of light, as they are not in the sense of Kirchhoff absolutely "black substances." If these materials are raised to a sufficiently high temperature, no matter by what means, the efficiency of production of light is remarkably high. Professor Nernst applies as the means to bring the bodies to a high temperature the electrical current, conducting it by small staffs of magnesia, chalk or other materials, the nature of which he keeps secret, after having prepared them to conduct the current by warming them.

The success obtained surpasses all expectations. With an energy of 27 watts (0.23 amp. at 118 v.) of alternating current Professor Nernst obtained, employing a hollow staff of magnesia (length 7 mm., thickness 1.5 mm.), a lighting intensity of 31 HE = 27 cp, or per watt 1.11 HE = 0.96 cp; an ordinary incandescent lamp wants 2.5 to 3.5 watts per cp.

It is necessary to work with alternating currents to avoid electrolytic action on the material employed. The importance of this invention if it can be practically employed—Professor Nernst, a true scientific man, advises us not to be too hopeful—can be seen at once. The cost of incandescent lighting would be reduced to about one-third of the present rate.

There is still the difficulty, however, that the filament, in order to be adapted to practical work, has first to be raised to a very high temperature. Professor Nernst has not so far given any explanation in what way—and it is highly important that it should be a practical and easy way—this warming will be effected. It is to be hoped that this as well may be done by the electrical current.

Commercial Electric Condensers.

At a recent meeting of the Société Internationale des Electriciens M. Boucherot gave the results of recent investigations concerning condensers for alternating current working. These condensers were of paraffined paper and tin-foil. A good piece of apparatus of this kind should neither heat nor make a humming noise while in use, but to attain these desirable ends requires careful choice of the materials employed and a certain experience in their construction. The insulation resistance diminishes rapidly as the temperature increases, or in other words, the energy lost in heating the condenser rapidly increases. There is, for each condenser, a tension limit that must not be passed or the temperature will increase up to the melting point of the paraffine or even to the volatilizing point of the tin-foil. This tension limit may be, according to the quality of the material, either above or below that required to pierce the dielectric. Furthermore, a condenser that works well at a given voltage and with current from a given source will not necessarily work well on a circuit subject to abnormal elevations of voltage or "peaky" waves.

As an application in practice M. Boucherot groups two self-induction coils and two condensers in a quadrilateral arrangement, such that similar apparatus occupy opposite sides. Then, if two opposite corners of the quadrilateral are connected to the terminals of a source of constant alternating E. M. F. a constant alternating current will flow through a circuit connected to the other two corners of the quadrilateral, no matter what its resistance or inductance may be. In demonstrating the principles of this arrangement and showing its applicability to industrial work M. Boucherot exhibited an arrangement of the sort fed by a constant potential alternating supply of 1,000 volts, and lighting incandescent lamps in series. The number of these lamps was varied from one to eighteen without any sensible change in their brilliance, the difference of potential at the terminals of the series varying between 100 and 1800 volts and the current remaining constant within a few per cent.

Two systems of self-exciting alternators were also shown. In one of them there is no field winding, but two armatures, one fixed and one revolving, alike in number of poles, winding, number of phases, etc. Both these are the seat of induced currents of the same frequency and tension, through the rotation of a field that is displaced in both with an angular velocity half that of the movable armature, and which is produced by the E. M. F. obtained from a condenser. The other system is composed simply of two circuits and a movable piece of iron, so combined that the first circuit has a variable self-induction, varying according to the formula

$$\lambda (1 + \sin 2\omega t),$$

the second circuit a similar variable self-induction of the form

$$\lambda (1 - \sin 2\omega t),$$

and between them a mutual induction varying according to the formula $\lambda \cos 2\omega t$. The addition of condensers then permits the withdrawal of currents of the forms $\sin \omega t$ or $\cos \omega t$. Triphase currents can be as easily generated from a similar arrangement using three fixed circuits. In this machine, as in the other, the condensers may be connected into each phase, either in series or in shunt with the working circuits. If they are connected in shunt the characteristic action of the machine is the same as that of a direct current shunt dynamo. If the condensers are in series the machine acts similarly to a direct current series machine. By combining these methods of excitation the machine may be compounded. A practical arrangement consists in connecting the condensers in parallel and regulating the tension of the working current by varying the air-space in the transformers used for reducing the potential for incandescent lighting. The small machine that was shown before the Société produced 1 ampere at 600 volts and very successfully illuminated a dozen incandescent lamps.

Rapidity of Filling Empty Passenger Cars.

On this important subject, which has been much discussed in connection with the radically different design of English and American coaches, the "American Machinist" brings out the new points given below:

The present writer timed a number of stops last spring on the London underground roads and found them to average about 29 seconds, and at the same time noted what appears to be the chief reason why stops are so long with the English style of car, in spite of its liberal provision of doors. People do get out of them quickly, but they cannot get into them quickly because after once entering a compartment there is no opportunity to go to another part of the train until the next stop, and consequently some care and discretion must be used in choosing which particular door to enter. First, a compartment of a certain class must be chosen, and then one of the class must be found in which smoking is allowed, or prohibited, according to the preference of the passenger, and, finally, a compartment of the proper class, with suitable regulations regarding smoking, and that has a vacant seat must be found. Then, when two or more wish to ride together, or when a man, with wife and two or more children, is looking for a compartment in which all can ride together the problem is sometimes difficult, and its solution often requires much walking back and forth on the platform and anxious peering into windows and doors, etc., all of which takes time. An American train can be entered at any point and seats found afterward, while the train is in motion.

Money versus Brains.

To the Editor of The Electrical World:

Sir—In the editorial columns of your issue of February 5 you compare the wages of professional engineers in the United States and the United Kingdom. In the latter country an example is given of a position for experienced electrical engineers advertised at a salary of $12.17 a week. You state that, judging from this example, salaries paid skilled engineers are lower in England than in the United States, and conclude that this may be the reason why the latter country is in advance of the former in some ways in engineering work.

The fact is that in most European countries salaries for educated men are only about one-half of those paid in America, and yet among these are countries where engineering and other professions are not behind those in the latter. For example, in the branches of medicine and law, most of the professors at leading universities in Europe are paid salaries equivalent to $1200 to $1600, while the same positions in America bring $2000 to $3500 per year. Still, it is well recognized that these sciences are of as high standing in Europe as in America, if not higher. In electrical engineering the salaries paid in Germany and Switzerland correspond closely to that given in your example in England, and yet in the former two countries electrical engineering is as highly developed as in America. It is true that in certain branches, such as street railway work, the United States is, owing to local conditions, ahead, but in other lines continental Europe can boast of equality or superiority. The reason why educated men obtain lower salaries in Europe than in America is undoubtedly to be found partly in the lower cost of living and largely in the lower cost of education, the latter accounting too for the fact that the general education of the average practical man in Europe is better than that in America.

Returning to the original question, and bearing in mind the comparison with Switzerland and Germany, I doubt whether the lack of enterprise in electrical engineering in England is due to the low wages paid, but think that the main reason is rather the conservatism of the British nation, a quality which in the last few years has given the more enterprising people of America and Germany many opportunities.

J. Sigfrid Edström.

Zurich, Switzerland.

The United States Patent Office.

The following is a brief abstract of an excellent argument made by Mr. Edwin J. Prindle in the March issue of the "Forum":

The complaint is made that our patents are so frequently upset in court that it is difficult to enlist the aid of capital in support of really meritorious inventions. In view of the comparatively small force in the Patent Office, it is strange that so large a proportion of the patents is sustained as is the case. Among the governments having patent systems in extensive use ours alone (with one exception, perhaps,) seeks to grant only such patents as will be sustained by the courts. There are about a million patents of all countries, besides numerous scientific publications, which must be considered in determining whether or not an invention is new. It is not impossible to perform this task with reasonable certainty; but, to do it, there must be a proper classification of the records, and ample time to consider them. At present the arrangement of the patents is such that usually there must be considerable doubt as to whether or not the field of search has been fully covered. Numerous questions of form and merit arise in connection with each application for a patent; and the conflicting claims of rival inventors necessitate long and complicated proceedings to determine who is entitled to the patent.

What judge woud undertake to make in one year over seven thousand preliminary and final decisions, many of which involve large sums of money, as does the primary examiner in one of the divisions of the Patent Office—and that division not the busiest one?

With a sufficiently large corps of examiners the invalid patents could be reduced to an insignificant number, so that capital might be more readily found for this form of investment. This inability of the Patent Office to cope with the enormous amount of work imposed upon it is, I think, the greatest difficulty in the way of the successful operation of the patent system. In view of the fact that the earnings of the Patent Office have exceeded its expenses by over $5,000,000, there should be no difficulty in securing the legislation necessary to increase the force of examiners.

The Management of Central Station Meter Systems.

To the Editor of the Electrical World:

Sir—Referring to the letter by William H. McDowell, in your issue of February 12, on "The Management of Central Station Meter Systems," I wish to say that I quite agree with Mr. McDowell in regard to the unreliability of meters of large capacity in the accurate measurement of loads varying over wide ranges. His suggestion of employing two meters is good and easily carried into effect. The dissatisfaction to consumers caused by incorrect registering is quite prevalent here, and a remedy is absolutely essential. In regard to the automatic switch suggested by Mr. McDowell, the accompanying

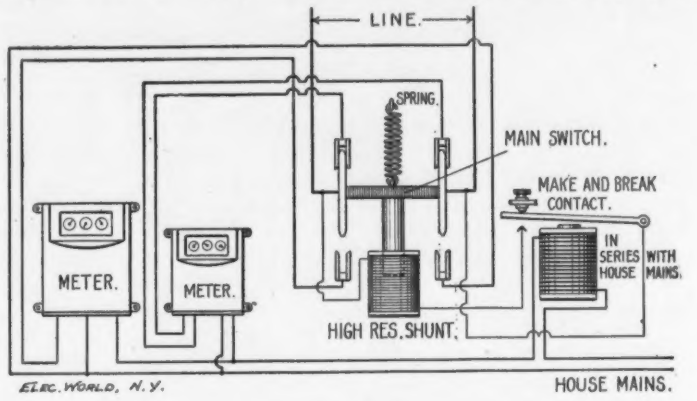


diagram indicates an arrangement of the connections which will, I think, give satisfactory results. With slight modifications it could be adapted for use on three-wire systems.

Halifax, N. S. J. Archibald Travers.

[One of the difficulties in this problem appears to be the construction of an electromagnet sufficiently powerful to close the main double-pole switch, and yet of sufficient sensitiveness to operate at all times on the same load (which should be manually adjustable) and also to open and close with the same flow of the main current. On account of the reduced reluctance of the magnetic circuit when the switch is closed (a considerable motion of the armature being necessary to properly actuate the switch blades) any ordinary magnet would not let go until the current had fallen to a value considerably below that at which it would again pull up the armature. This, of course, is a serious failing. By the relay device, suggested in the above letter by Mr. Travers, the sensitive magnet controls only a very small current and its contacts can be comparatively light and of small opening, thus largely eliminating the difficulty mentioned. A further development which suggests itself with this arrangement, when used with wattmeters with shunt circuits, is the connection of the shunt circuit of the larger meter in the circuit of the relay armature, thus throwing it out of circuit when the meter series coils are cut out and preventing the waste of current at light loads. In fact, the coils of the magnet of the main switch could be inserted in series with the shunt winding of the large meter in place of the idle resistance customarily used, thereby avoiding the use of any extra energy in operating the main switch.—Editors.]

The Telegraph and Telephone in British Guiana.

The following information concerning the governmental telegraph and telephone lines of British Guiana has been furnished by Mr. H. Guthrie Spain, acting electrician of the post office, with headquarters at Georgetown. The telegraph system comprises 471 miles of overhead line and 84 miles of submarine cable. With two exceptions the lines are worked on the closed circuit system. The cable to Bartica, which is laid for 40 miles in the Essequibo River, is operated with the Morse code, using reversed currents. Between all points in the colony there is charged a flat rate of 12 cents for ten words; 18 cents for fifteen words; 24 cents for twenty words; 30 cents for twenty-five words, etc., addresses free.

The Government also maintains three telephone exchanges, a general exchange in Georgetown with 425 subscribers; a police exchange with twenty stations, and an exchange in New Amsterdam with about 100 subscribers. The rates for service within 1¼ miles of the exchanges are $24 per annum for business houses, and $12 for private houses. Western Electric switchboards are used. Six hundred and ten miles of wire are used in these telephone exchanges.

Digest of Current Electrical Literature

American and Foreign.

by Carl Hering.

Dynamos, Motors and Transformers.

SPARKING IN DYNAMOS. Thomas. Lond. "Elec.," Feb. 18.—He describes the cause of sparking, which is now generally understood, and then explains what he thinks is the true action of the carbon brushes; briefly this is, that owing to the resistance through the brush from one bar to the other the current flowing through the edges of the brush provides the reversing E. M. F. in the short circuited coil which is necessary to prevent sparking; moreover, this E. M. F. is self-adjusting, for if the armature currents are large the potential difference between the bar and the brush will be large; this explanation implies that there should be a difference of potential between that part of the commutator under the leading edge of the brush and that part under the trailing edge; curves determined experimentally are reproduced which confirm this. He thinks many of the troubles which produce sparking have been attributed to the wrong causes. He then develops some rather complicated equations, giving what he calls the sparking criterion, but they do not seem to be of a practical nature, although they are claimed to be of some value as a guide. It appears at first sight that the output should be increased by decreasing the contact area of the brushes, thereby increasing the contact resistance, but this is contrary to experience, which shows that there is a certain maximum safe current density for each type of brush; the output of a machine can be increased only by re-designing it, so that it has a lower inductance per coil, or to have the circuit of the self-induced magnetism magnetically worse. In actual practice it is found easy to keep the inductance of the armature coils so low, even with slotted armatures, that the heating limit is reached before the sparking limit, even with small air gaps; the armature reaction is also kept low by making a machine multipolar.

SELF-EXCITING ALTERNATOR. Boucherot. "L'Eclairage Elec.," Feb. 12.—A brief abstract of a paper read before the International Society on the application of condensers. In one form there is no inductor, but there is a fixed and a movable armature which are identical in number of poles, phases and windings, and therefore have like currents induced by the rotation of a field which revolves with half the velocity of the moving armature and is produced by the currents obtained from the condenser. He constructed such a machine of 18 kilowatts; it must be started each time, as it did not have enough permanent magnetism, but it has a very large specific output. The other form contains only two stationary circuits and a piece of moving iron, so proportioned that the first circuit has a self-induction varying according to a certain formula, and the other one varying according to another formula, their mutual induction varying according to still another law; the addition of condensers enables currents of a certain form to be obtained. Tri-phase currents can be obtained in a similar way; the condensers may be connected in series or in parallel; in the latter case the dynamo will have the characteristics of a shunt machine and in the former of a series machine, while a combination of the two gives the characteristics of a compound machine.

STARTING NON-SYNCHRONOUS MOTORS. Arno. "Elek. Zeit.," Feb. 17.—An author's translation in abstract of the two recent papers read before the Italian Electrical Society, and duly noticed at that time.

OPENING FIELD CIRCUITS OF DYNAMOS.—Lond. "Elec. Eng.," Feb. 18.—Answers to a request to show the best type of switch for opening the field circuits of large separately excited dynamos and alternators; several illustrated answers are given.

Lights and Lighting.

TRAIN LIGHTING.—"Zeit. fuer Elek.," Feb. 13.—A short article enumerating the plants in use; it is claimed that this shows undoubtedly that in a short time nearly all railroads in Europe will use electric lighting for the cars.

DIFFUSED ILLUMINATION. Hallock. "Prog. Age," March 1.—A short article giving an illustrated description of a novel form of diffused illumination in the dome of the new Columbia University, in New York City; frequent references to other descriptions have already been given. There is a white opaque sphere 7 feet in diameter suspended from the top of the dome, on to which are directed beams of light from eight corners, in each of which there is a projecting lantern, each throwing a disc of light on this sphere about 6.5 feet in diameter, which glows with a pale diffused light. This method is not as economical as naked arc lights, but it has great advantages in the convenience of trimming. While it is possible to read by this light with considerable ease on the floor of the reading room, yet it is not intended for this purpose, as the tables have separate lights. The approximate candle-power is about 500, although the impression is that it is much greater. The whole lighting of the room will not take 300 amperes, while in the Congressional Library, which is only 1 per cent. larger, 900 amperes are required. In an editorial reference it is called artificial moonlight, and is spoken well of, the method being considered a success; crude tests showed an illumination of 0.01 to 0.02 foot candles on the floor, which is less than that by a full moon at its highest altitude. Projecting light against the white surface is less wasteful than passing it through ground glass or an opal globe, the former absorbing 20 per cent. and the latter 60 per cent.

USE OF CARBON STUMPS.—"Cassier's Mag.," March.—A note stating that the unburnt ends from arc lamps have been found to be useful for making small charcoal fires of great heat and purity, suitable for special kinds of small work which are not interfered with by the copper coating.

Power.

UTILIZATION OF THE TIDES.—"L'Elec.," Feb. 19.—A brief description of a plant at Ploumanach, on the northern coast of France, where the tides are very high, enabling a fall of 40 feet to be utilized; in the present installation 12 to 15 feet are used as a mean; at present it is used for making 450 kg of ice per day, but a dynamo for lighting purposes in conjunction with accumulators is soon to be installed, with a capacity of 1500 to 2000-hp hours per day.

POWER DISTRIBUTION FROM COLLIERIES.—Lond. "Elec.," Feb. 18.—An editorial stating that the Midland Company is preparing to supply electrical energy for manufacturing purposes for 2 cents per kilowatt hour, 12 cents for lighting for the first hour, and 6 cents thereafter. The best system to be used is discussed, and it is narrowed down to the two phase or three phase, the latter being thought to be the better of the two.

WATER-POWER PLANT AT PADERNE.—"L'Eclairage Elec.," Feb. 12.—A brief abstract of an article describing this plant, which supplies Milan, in Italy.

GAS ENGINES FOR ELECTRIC LIGHTING.—Lond. "Elec. Rev.," Feb. 18.—A brief description of a small plant.

POWER DEVELOPMENT IN SOUTHERN CALIFORNIA. Finkle. "Eng. Mag.," March.—An article pointing out the benefits from the development of hydraulic power in Southern California, and describing with the aid of illustrations some of the plants. A watershed map of Southern California is also given.

Traction.

BAR CONTACT FOR ELECTRIC RAILROADS. Stobrawa. "Elek. Zeit.," Feb. 17.—An illustrated description of the system used in Dresden in preference to the trolley, for making contact with the trolley wire. In that city there are 165 motor cars, and the experience with these has led to very satisfactory results. At first a horizontal bar of iron was used, being the upper side of a light vertical rectangle on the top of the car. This was then replaced by one of brass surrounded by the metal used for bearings, in order to diminish the wear on the trolley wire; another improvement which also caused less noise to be made, was to provide the bar with two grooves of aluminum containing grease for lubrication; the frame was also changed into a triangle and the upper side was slightly bowed. The life of one of the bars coated with soft metal was about two weeks, after which the coating is renewed; when provided with grease it is six to eight weeks, or about 8000 car km; the cost of maintenance is about the same for both, being 0.017 cents per car km; the upward pressure is limited by law to 3.5 kg, and is generally much less. This system has the advantages over the trolley system that the wire need not be so carefully placed over the middle of the track and less supports at curves are required. It has often been thought that the wear on the trolley wire is greater with this than with the trolley, but experience has shown that this is not the case; the trolley often rubs on its flanges, especially at curves, where it wears the wire badly; with the bar the wear is at first more rapid, but after that it is scarcely measurable, as was shown by repeated carefully made measurements; after four years the vertical diameter of the wire was 0.4 mm less, and the cross section was still 96 per cent. of the original; on many long stretches the wear was less, while on curves it was somewhat greater. On some of the lines in that city on which the trolley was used it has now been replaced by the bar.

SUBURBAN AND RAPID TRANSIT CITY LINES. Pellissier. "L'Eclairage Elec.," Feb. 12.—The first part of an article in which he discusses the various conditions on which the practicability of using electric power depends; much of the information given is obtained from the American lines of that kind, more particularly the Nantasket Beach and Hartford lines. He calculates the proper distance between the stations and gives a table showing the proper distance between stations of a suburban line which could compete with street railways, making allowance for the time it takes to walk to the stations. The importance of rapid acceleration is discussed with the aid of some curves taken from actual cases and with a table based on American practice.

ELECTRIC AND HORSE-DRAWN CABS.—Lond. "Elec. Rev.," Feb. 18.—Two tables giving the itemized daily costs for each in Paris; the total for a horse-drawn cab is about $3, and for an electric cab about $1.80. In another part of that journal the daily cost of keeping two horses and of an automotor vehicle are given, taken also from French sources; the total for the former is $1.89, and for the latter with a daily journey of thirty miles, using petroleum as fuel, is 90 cents, and it is claimed that the automotor is always much cheaper.

COST OF PRODUCING ELECTRICAL ENERGY. Shallcross. Lond. "Elec. Rev.," Feb. 18.—Some estimates showing that it is not only possible but quite easy for traction stations to supply current for 2.5 cents for railway work.

CENTRAL LONDON UNDERGROUND RAILWAY.—Lond. "Engineering," Feb. 18.—The first part of a descriptive article on this electric railway which is in progress; the present portion is general in character, but an illustrated description of the engineering features is promised in subsequent issues.

ELECTRIC CARS IN TOKYO CITY, JAPAN.—"Electrical Friend" (Japan), Jan.—Several companies were organized and tried to get permission for a long time to introduce the trolley system, but the Government prohibits the overhead wire system.

Installations, Systems and Appliances.

STARTING A MUNICIPAL ELECTRIC DEPARTMENT. Steinitz. Lond. "Elec.," Feb. 18.—Abstracts from a recent paper giving some practical hints obtained from experience.

USE OF ACCUMULATORS IN CENTRAL STATIONS.—Lond. "Elec. Eng.," Feb. 18.—Answers to a request to discuss the financial and other advantages of accumulators in a moderate sized sized station.

THE METER AND THE LOAD CURVE. Perrine. "Elec. Eng'ing," March 1.—A short article. A general introduction of meters increases the extent of territory operated by a given amount of machinery, but it does not decrease the cost of the current to the central station by a corresponding amount; it increases the irregularities of the load curve and decidedly increases the fixed expenses per kilowatt for the lines; a flat rate system flattens the load curves; the Wright system, while its principles are recognized, interferes with the sale of current under the conditions usually met with in competition with other means of furnishing light and power; it depresses the peaks rather than filling up the hollows; it diverts business in some cases, and suppresses it in others; it is perfectly successful and satisfactory for large amounts of power. The two-rate meter system has many advantages; it is more easily understood by the purchaser, but it does not take into account the yearly load curve which should be considered. There should be a more regular connection between the station output and the charges than is now offered, and if it could be possible to frame contracts such that the rate would be based on the load at the station rather than the time of day, even a higher premium might be allowed; it would do away with the present disadvantages in the overlapping of the power and light demands, and would tend to level up the whole curve, not only for the day but for the year.

SPRINGFIELD MUNICIPAL LIGHTING PLANT. Burke. "Elec. Eng'ing," March 1.—A short article giving what are called the facts regarding this so-called municipal plant.

Wires, Wiring and Conduits.

UNDERGROUND TELEPHONE CIRCUITS IN STOCKHOLM. Hultman. "Elek. Zeit.," Feb. 17.—The first part of an article describing the system used. It was decided that the drawing-in system is preferable, and that blocks of insulating material pierced with holes are the cheapest method; this is the one used and described with the aid of illustrations.

Electro-Physics and Magnetism.

CATHODE RAYS. Wiedemann and Schmidt. "Wied. Ann.," 62, p. 603; abstracted, with an illustration, in the "Elek. Zeit.," Feb. 17.—The rays appear as two different kinds, one as a slightly diverging solid cone and the other as a mantle of a cone of rather large angle, producing a green ring on the walls; they endeavor to show how these originate.

COMPLEX CATHODES. Wiedemann. "Wied. Ann.," No. 13; noticed briefly in the Lond. "Elec.," Feb. 18.—He describes some peculiar phenomena illustrating the mutual influence of the several parts of a cathode; the rays proceeding from one surface and impinging on the dark space due to the other are deflected by the latter.

FOCUS TUBE RAYS. Villard. "L'Eclairage Elec.," Feb. 12.—An abstract of a French Physical Society paper, in which he showed the properties of the rays which produce the hemispherical illumination of focus tubes above the plane of the anti-cathode.

PERPETUAL MOTION OF THE SECOND ORDER. Frank. "Elektrochem. Zeit.," Feb. 1.—The conclusion of his article (see "Digest," Feb. 5). He continues the theoretical discussion of the question of energy and the application to such motive powers. A theory of the radiometer is given.

ELECTRIC VALVES. Blondin. "L'Eclairage Elec.," Feb. 12.—A historical summary of the researches in this field, by an electric valve being meant an electrolytic apparatus which will allow a current to pass in one direction but not in the other. He concludes that the phenomenon of electrolytic rectifiers was discovered in 1857 by Buff and re-discovered in 1875 by Ducretet; also that the results obtained at the present time, although they may be encouraging, are not yet of such value as to be used in practice; he recommends making researchs in this direction.

ELECTROMAGNETIC INDUCTION IN CURRENT SHEETS. Bryan. Lond. "Elec.," Feb. 18.—A brief abstract of a Physical Society paper on electromagnetic induction in plans, cylindrical and spherical current sheets and its representation by moving trails of images.

ELECTRIC RADIATION. Bose. Lond. "Elec. Rev.," Feb. 18.—A brief abstract of two Royal Society papers describing experiments referring to refraction and total internal reflection by glass.

POLARIZATION OF LIGHT IN THE MAGNETIC FIELD. Lorentz. "L'Eclairage Elec.," Feb. 12.—A long abstract by Cotton of this paper from the September number of the publication of the Amsterdam Academy of Sciences; it is on the partial polarization of the light from a flame placed in the magnetic field. The same French journal also contains a short article by Cotton supplementary to this one, giving some experimental details and offering some explanations, with special reference to the experiments of Egoroff and Georgiewsky.

CHANGE OF LENGTH OF MAGNETIZED IRON.—"Elek. Zeit.," Feb. 17.—An editorial giving a review of researches made of the change of length of iron bars due to magnetization, with special reference to the recent work of Klingenberg and of Brackett. It is thought that the use of this property for practical purposes may not be impracticable; some of the data from these researches are given.

MAGNETIC PROPERTIES OF TEMPERED STEEL. Madame Curie. Lond. "Elec.," Feb. 11.—An abstract of the article noticed in the "Digest," Feb. 5.

DEMAGNETIZING FACTOR. Ascoli. "L'Eclairage Elec.," Feb. 5.—An abstract of a paper from the Italian, in which he compares a bundle of wires with solid cylinders; a table giving the lengths and the corresponding demagnetizing factors shows that there is practically no difference in the two forms of cores.

MAGNETISM AND CONCUSSION. Fromme. Lond. "Elec.," Feb. 11; abstracted briefly from the "Wied. Ann.," No. 13.—He investigated the connection between the magnetic properties of a wire or a coherer, and electric discharges through or near them. The influence of the waves on the magnetic properties as a whole is negligible, and a search for a temporary change for the purpose of signalling must therefore be fruitless; a discharge through the coherer or wire has the effect of a mechanical shock; no amount of shocking will bring about the state in which the minimum permanent magnetism is established immediately on magnetization; this minimum is of great practical importance, and can best be brought about by alternate magnetization and concussion; constant permanent magnets may be obtained in this manner.

JAMIN MAGNETS. Ascoli. "L'Eclairage Elec.," Feb. 5.—A longer abstract of the paper noticed in the "Digest," Feb. 19.

MAGNETIC PROPERTIES OF IRON.—"Zeit. fuer Elek.," Feb. 6.—Long extracts from the reports of the Reichsanstalt, giving results of tests made there on some of the new kinds of iron, and including determinations of the Steinmetz hysteresis coefficient. They have been referred to before.

MAGNETIC SHIELDING. Du Bois. Lond. "Elec.," Feb. 11.—A continuation of the article noticed in the "Digest," Jan. 22.

MAGNETIC FIELD DUE TO A CURRENT PARALLEL TO A CYLINDER. Searle. Lond. "Elec.," Feb. 11.—The conclusion of the article noticed in the "Digest," Feb. 19. No general conclusions appear to be drawn.

FIRE FLY LIGHT. Muruoka and Kasuya. "Wied. Ann.," No. 1; abstracted in the "Am. Jour. of Sc.," March.—They re-examined the phenomena described by the former some time ago, and found that the property of this light, namely that when filtered through paper or cardboard it could affect a photographic plate, was due to moisture in the cardboard, which brought out a peculiar property of the latter; this moisture was doubtless communicated by the insects; water vapor alone did not produce the effect. Various organic substances were tried, and photographic effects were produced by a large number of them, among which were resin, coffee, camphor, etc.; zinc, cadmium and magnesium also acted upon photographic plates; cadmium oxide exhibited an effect which cannot be ascribed to radiation or vaporization.

EFFECT OF RONTGEN RAYS ON VEGETABLE LIFE. Tolomei. "Elec. Eng.," Feb. 24.—A brief abstract of a paper from the Italian. He concludes from experiments that their action is identical with that of light; on the bacillus and anthracis the Röntgen rays behave just like sunlight, but in a minor degree; he attributes previous failures to obtain this effect to the short duration of the exposures.

Electro-Chemistry and Batteries.

RESEARCHES WITH PLANTE-TUDOR PLATES. Pfaff. "Elektrochem. Zeit.," Feb. 1.—An article in which he describes very extended researches made with single test plates of the Tudor type (having deep grooves, the cross section representing a comb). A

series of these cells with different strengths of acid was formed with a current of 0.5 ampere per sq. dcm. of positive plate, as determined from the dimensions and not including the surface of the ribs; the voltages after seventy hours are given; it was found that at a density of about 10° B. the formed material is less apt to fall off; the highest capacity at discharge was obtained with a concentration of 14 to 16° B.; other tests show that the plate thus formed should be charged and discharged a few times before being pasted with active material; if this is not done it will take twelve to fifteen discharges to give the same capacity, while if not formed at all it will take fifty discharges; a plate which is not pasted at all will require many more discharges to acquire that capacity. Other tests made with alternate formations in the opposite directions did not give better results, but this might be due to the fact that they were not frequent enough. It was found that the ribs had better be vertical than horizontal. He endeavored to find how the capacity changes if the charge is stopped at different voltages; the results are given in a table, which shows that by doubling the charging and discharging current the capacity is reduced to two-thirds; he also found that the capacity increases proportionally with the end voltage at charging, other things remaining the same; the capacity for any discharge may therefore be calculated from that for any given one. He compared his results with those obtained by an Austrian company, and found they agreed. He showed that charging up to 2.3 volts and up to 2.7 is not rational; it is not well to increase the load up to 5 amperes per sq. dcm.; all charges up to 2.4, 2.5 and 2.6 volts and with 1.5 to 4 amperes give good results; this means a discharge in three to one-half hours, which therefore is practicable. He endeavored to determine the most favorable charging and discharging currents, and found that charging and discharging current from 1.5 to 5 amperes per sq. dcm. all give good results; it even appears that charging with large currents gives a better efficiency than with small ones. The life tests show that the capacity at 5 amperes, charging at 2.6 or 2.7 volts, did not change during 1500 discharges.

CONCENTRATION OF THE ACID IN ACCUMULATORS. Dolezalek. "Zeit. f. Elektrochemie," Feb. 5.—He discusses the dependence of the E. M. F. and the efficiency of a lead accumulator on the concentration of the acid. He assumes at the start the well known simple chemical reaction in accumulators, namely, that lead sulphate and water are formed with the discharge, and then discusses theoretically the effect of the strength of the acid, basing it on an application of the principles of thermo-dynamics to the processes in the accumulators, to which he claims no objection can be made; he claims to have proved the dependence of the E. M. F. and efficiency on the concentration; the calculated and observed results are given, and show good agreement; he claims that this shows that the chemical action is as stated, and none other. During charge the accumulator acts as though the concentration was greater and during discharge as though it was less; this shows why the difference is about one-tenth of a volt; he claims that the equalization of the concentration is due to electrical "streams," and that the concentrated and dilute acid together develop a difference of potential; if this is correct, then the effect of various factors on the loss of energy could be calculated; he gives his formula for the dependence of the energy loss upon the mechanical construction of a plate and shows that for the same charging and discharging current there would be a maximum efficiency if the acid has its maximum conductivity, at which the density is 1.224; Earle obtained 1.23 experimentally, which confirms his formula; the calculated and observed values of other cells are also given. If the formula is correct, it will not be necessary in the future to determine the efficiency experimentally for different current strengths, as a single measurement at any convenient current strength will suffice to determine the value of a certain factor which thoroughly characterizes the accumulator.

ACCUMULATOR.—Lond. "Elec. Rev.," Feb. 18.—A short description of the Allan accumulator, which has been in use in England for nearly three years. It has a pasted plate in which the active material is supported in a hollow frame which is cast in a very ingenious way, not described; the frame supports the active material wholly from the outside. Forty cells of 210 ampere hours weighed complete 1300 pounds as used for vehicles.

ALKALI PROCESS. Kershaw. Lond. "Elec.," Feb. 18.—A brief description with some illustrations of the plant using the Hargreaves-Bird process near Widnes, England. The plant has now been running continuously for over two years, and many improvements have resulted; no previous description of the plant has been published; the process is about to be used on a large scale in France; common salt is used; the general principles of the process have already been described; the engine generates only about 20 horse-power; the anodes are made of roughly shaped blocks of gas carbon, strung like beads, on a rod of lead. The results of some analyses of the process are given. A description of this plant by Kershaw is also given in "El'ty," N. Y., March 2.

TREATMENT OF ORES CONTAINING PRECIOUS METALS. Webber. Lond. "Elec.," Feb. 18.—The conclusion of the reprint of his paper (see "Digest," last week). The latter part deals with a description of the Pelatan-Clerici process, for which great claims are made; it appears to consist in treating the pulverized ore mixed with water, by means of chlorine produced electrolytically from common salt, and then extracting the gold with potassium cyanide; this is done in a vessel with a revolving anode and a mercury cathode; the sodium liberated at the cathode acts as a quickener to the mercury.

The discussion is abstracted in the Lond. "Elec. Rev.," Feb. 18.—Sulman criticises this process very unfavorable, and brought up a number of questions, among the most important of which was the question of cost.

TREATMENT OF WINE.—"Elektrochem. Zeit.," Feb. 1.—A note stating that the electric current can impart to wine in a few hours that property which it otherwise takes a long time to acquire in casks. The apparatus for sweetening sour wine electrolytically is then briefly described; it appears that the wine is electrolyzed between carbon electrodes, the negative being in the wine, and the other in a cylinder containing diluted alcohol, separated by a diaphragm; the current generates hydrogen, which destroys the acid; it seems to be important to see that the current strength does not exceed a certain amount.

ELECTRO-CHEMICAL ACTINOMETERS. Rigollot. "Am. Jour. of Sc.," March.—A long abstract of a paper published in the Annales of the Univ. of Lyons, giving the results of a series of experiments, the object of which was to investigate the E. M. F. generated by the action of light on one of two metallic plates in an electrolyte, the other being in darkness; actino-meters, which are very sensitive to light, can be made with the materials mentioned.

ANALYSES OF BRONZES. Hollard. "Elektrochem. Zeit.," Feb. 1.—An abstract of a paper read before the French Chemical Society, describing a method of electrolytic analysis of alloys of copper, zinc and tin.

GERMAN ELECTRO-CHEMICAL SOCIETY.—"L'Eclairage Elec.," Feb. 12.—A continuation of the abstracts of the papers read at the Munich meeting of the society last year; all of these papers were duly noticed at that time; the present abstracts are not very brief.

ELECTROLYTIC PRODUCTION OF ZINC. Hoepfner process. "Eng. and Min. Jour.," Feb. 26.—An illustrated description of this process, taken apparently from a recent patent. He uses a chloride solution with disc-shaped rotating cathodes, which are only immersed; high current densities can be used.

Units, Measurements and Instruments.

CONDENSERS. Boucherot. "L'Eclairage Elec.," Feb. 12.—A long abstract of a paper read before the International Society on industrial condensers and their application to distribution at constant current and to self-excited alternators. He made them of tinfoil and paraffin paper; the qualities of high resistance and resistance to piercing are antagonistic; the heating is chiefly due to the Joule effect, that is, to leakage current, the action of dielectric hysteresis, if it exists at all, being very slight; the insulation resistance should therefore be as great as possible, and the nature of the insulation material in the paper is therefore of great importance; experiments made with oil and paraffin at different temperatures show that the latter is by far the better; as the condenser heats the resistance diminishes, and this in turn increases the leakage current, which increases the heat, the process continuing until the condenser is burnt out; one which does not heat more than 8° C. above the surrounding temperature is satisfactory, and one which heats 30° should be rejected, as this will constantly increase; to prevent the heat from increasing, the amount generated should be less than that radiated from the surfaces; as the heat loss must be small, only such condensers as have a very high efficiency should be used. He then describes tests which he made with condensers; he concludes that they should be applied to circuits only with the greatest care, and in the present form they are applicable only to small installations; the cost per kilowatt varies with the voltage and the frequency, and is from $20 to $30 for a frequency of 40; this he shows by comparison to approach the price of the other apparatus, such as generators, transformers and motors. In the application of condensers he shows that together with a self-induction they may be used to give a constant current which is not dependent on the impedance of a circuit; two condensers and two self-inductions having a certain relation to each other are connected somewhat like a Wheatstone bridge, the similar parts being on opposite sides; by connecting two corners to a constant E. M. F. a constant current is obtained from the other two, regardless of the resistance or reaction of that circuit. The application to a self-exciting alternator is described in an abstract above, under that title.

MEASUREMENT OF INSULATION RESISTANCE BY ALTERNATING CURRENTS.—Lond. "Elec. Rev.," Feb. 18.—A short editorial article discussing some of the recent articles in German and French journals describing methods for testing the wires. The following method is then suggested: The testing current is taken from the mains; the circuit should be connected to one pole of the supply mains through a non-inductive resistance and the voltage between the terminals of this resistance and between the conductor and the earth should be measured with an electrostatic voltameter; the insulation resistance is then equal to the non-inductive resistance divided by the voltage across the terminals of the resistance and multiplied by the difference between the voltage to earth and that at the terminals of the resistance. The article is reprinted in "El'ty," N. Y., March 2.

CALIBRATING A BALLISTIC GALVANOMETER WITH A SELF-INDUCTION COIL. Wien. "Wied. Ann.," 62, p. 702; abstracted briefly in the "Elek. Zeit.," Feb. 17.—Instead of calibrating a ballistic galvanometer with the aid of a condenser of known capacity, or by the Thomson method, with the aid of a long magnetization coil with primary and secondary windings, a coil of known self-induction, such as a Wien standard, may be used with a reversion of the Maxwell method of measuring the self-potential by

means of a Wheatstone bridge and ballistic galvanometer. Then he describes, the formulas being reproduced in the abstract.

STANDARD INDUCTANCE. Froehlich. "Wied. Ann., No. 13; noticed briefly in the Lond. "Elec.," Feb. 18.—A description of a standard of self-induction which can be calculated with extreme accuracy. It consists of a ring of Carrara marble wound with a single layer; it is 35 cm. broad and 20 cm. thick, weighing over 100 kg.; the coefficient is approximately 0.1 by 10 to the ninth power, cm.

USE OF THE COPPER VOLTAMETER. Foerster. "Am. Jour. of Sc.," March.—An abstract of the article noticed in the "Digest," June 19..

Telegraphy, Telephony and Signals.

TELEGRAPH AND TELEPHONE STATISTICS IN JAPAN.—"Electrical Friend" (Japan), January.—Statistics from the official report for the end of March, 1897. For telegraphy these were as follows: Length of line, 12,607 miles; length of wire, 40,266 miles; number of telegraph offices, 1125; number of instruments, 1854; excess of income over expenses, $433,082. For telephony: Length of line, 555 miles; length of wire, 7259 miles; number of exchanges, 6; number of call offices, 25; number of subscribers, 3232; number of switchboards, 32; number of telephones, 3351; excess of income over expenses, $17,707.

WIRELESS TELEGRAPHY. Voisenat. "Bul. Soc. Int. des Elec.," Jan.—The publication in complete form of his paper before that society, which was noticed in the "Digest," Feb. 19; it is very long and contains numerous illustration.

WIRELESS TELEGRAPHY IN JAPAN.—"Electrical Friend" (Japan), January.—Experiments in which induction coils, secondary coils, Morse instruments, etc, were used, and conducted by Matsushiro, electrical engineer of the Department of Communication, gave very successful results at a distance of 1 mile between the shore and the ship.

CABLE SHIP.—"Electrical Friend" (Japan), January.—The Japanese repair ship "Okinawa-Maru" is repairing the submarine cable between China and Formosa, which Japan occupied during the recent war. The captain and electrical engineers on board are all Japanese.

SUBMARINE CABLE REPAIRS. Gray. Lond. "Elec.," Feb. 18.—A correction of the table noticed in the "Digest," Feb. 26.

INDEPENDENT TELEPHONE COMPANIES.—"West. Elec.," Feb. 26.—The greater part of this issue is devoted to articles and notes on this subject. Brief biographical sketches, with portraits, are given of a number of men who are interested in these movements; illustrated descriptions of a number of exchanges are given. An article by Dodge on the expansion of independent systems is accompanied by a map showing the Michigan State lines and connections. There is a short article on the independent telephone movement in Chicago. Another by Thomas on the influence of organization in the independent telephone movement. A number of telephone protective devices are described and illustrated An illustrated article by Clausen on the art of constructing telephone apparatus gives a brief description of the general principles involved in the construction of various parts of telephone apparatus.

SIGNALLING WITHOUT CONNECTING WIRES. Lodge. "Elec. Eng.," Feb. 24.—A reprint, with the illustrations, of the article noticed in the "Digest," Feb. 19 and 26.

Miscellaneous.

DANGER IN TOUCHING CIRCUITS. Andriessen. "Elek. Anz.," Feb. 17.—A short article discussing the conditions governing fatalities of this kind. With alternating current circuits the cause of danger appears to be in the charging currents which flow through the condenser made up of the conductor and the earth, and he endeavors to prove this. In an armored cable a person touching the conductor closes the circuit of the condenser toward the earth; the resistance of the body, although high, is very small in comparison with the insulation resistance, and the fatalities may therefore be explained by the passage of the current, as these charging currents are undoubtedly large enough to do damage; with a voltage of 2000 and the usual frequency, a cable of 1 km. under the conditions named has a charging current of 1 ampere toward the earth; this was shown by experiment; if, for instance, an unloaded network, without transformers, is connected to a source of alternating currents through an incandescent lamp, the lamp will glow when the wires exceed one-half km. in length. This is also the case with multiphase currents when the network is made of single wires, and it then makes no difference which of the wires are touched; when concentric cables are used, however, the relations are changed; only the inside conductor in such a case has a high voltage toward the earth, while the outside one has practically none; the danger is therefore limited to touching the inside wire, as the charging current of the outside wire toward the earth will flow through the person touching it; the touching of a circuit is not always fatal, which is probably due to the fact that the resistance does not always fall sufficiently rapidly to allow the necessary current to pass, and this shows how danger may be guarded against, as it is only necessary to connect the conductor to earth to protect the party touching it; this connection with the earth can be made automatically by using the increase of voltage at the other conductor when the first is touched; he thinks this could be used in practice; a device would be connected to each of the wires, which, when the voltage becomes too high, connects the other wire to earth; the more rapidly this is done the less the danger. A similar device may also be used for continuous currents; in such circuits the voltage toward the earth depends on the insulation resistance, and in circuits which are well taken care of it is less than half the machine voltage; when a conductor is touched the voltage of the other wire to the earth will increase, and this may be used to operate the apparatus.

DEATH BY ELECTRICITY. Hedley. Lond. "Elec. Rev.," Feb. 18.—An article discussing the real causes of death by electricity. A short application of a 1500-volt alternating current sometimes did not kill rabbits, and yet much lower voltages have often proved fatal to man; many factors are involved, among them the duration of the application; the post-mortem appearances are enumerated, and there is a tolerable uniformity in the case of animals; death results in one of two ways, either by mechanical lesions of vital structures or by the arrest of the organic functions essential to life; lightning kills in the first way, while industrial currents kill in the second way; the question in the latter is which of such functions are affected first, and it is here where physiologists do not agree. The results of experimenters are given briefly, and the various hypotheses are not necessarily at variance, as death may be accomplished by various physiological mechanisms, such as the arrest of respiration or the stoppage of the heart action; the damage to the structure of the heart may ultimately turn out to be the cause. Nitrate of amyl administered to an animal makes it more difficult to kill by electric currents, and the use of this drug in such cases may prove a valuable adjunct to artificial respiration.

ELECTROLYTIC PROCESSES FOR MAKING PARABOLIC REFLECTORS. Cowper-Cowles. Lond. "Elec. Eng.," Feb. 18.—A reprint of a fully illustrated Institution paper, an abstract of which was published in our English Notes last week.

TRANSFORMATION OF HEAT INTO MECHANICAL WORK. Deprez. Lond. "Elec. Rev.," Feb. 18.—A translation of the article noticed in the "Digest," Feb. 26.

ELECTRIC COOKING APPARATUS.—"L'Elec.," Feb. 19.—Illustrated descriptions of various forms made in France and England.

ABSTRACTS.—According to the Lond. "Elec.," Feb. 18, the abstracts of scientific articles formerly published separately by the London Society and the Institution of Electrical Engineers now appear in a joint publication called "Science Abstracts," the first number of which is issued. The abstracts are under ten headings, of which two relate to electrical theory and science, four to electrical engineering and practice, and the remaining four to the other branches of physics.

MAGNETIC CONCENTRATION OF ORES. Anthony. "Cassier's Mag.," March.—A long, well illustrated article, the first part of which is general in character, showing the gradual development of concentrators, describing with the aid of good illustrations a number of different forms; the greater part is on the Wetherill separators in use in Northern New Jersey; numerous descriptions of this system have already been referred to in the "Digest."

CONVENTIONAL ELECTRICAL DIAGRAMS.—"Elec. Eng.," Feb. 24, "Elec. Rev.," March 2, and "West. Elec.," Feb. 26; begun in "El'ty," Feb. 23.—Reprints of the conventional diagrams proposed by a committee of the Chicago Electrical Association, and accompanied by a brief statement concerning them.

ARTIFICIAL INDIA RUBBER.—"Sc. Am. Sup.," March 5.—A short article on the researches of Tilden in England, taken apparently from the New York "Sun." He claims to produce india rubber from isoprene, which is derived from the oil of turpentine.

ELECTRIC HEATING AND COOKING. Adams. "El'ty," March 2.—The beginning of a reprint of the article noticed in the "Digest," Feb. 19.

MUNICIPAL OWNERSHIP. Lake. "Elec. Eng'ing," March 1.—A short article unfavorable to it.

BIOGRAPHICAL.—"Elec. Eng'ing," March 1.—A short biographical sketch, with a good portrait, of the late Dr. Wietlisbach, who has written many excellent articles on telephony; a list of some of his literary productions is given.

Book Reviews.

TRANSPORTABLE AKKUMULATOREN.—Anordnung, Verwendung, Leistung, Behandlung und Prüfung derselben. (Portable Accumulators. Their Preparation, Application, Performance, Methods of Handling and Testing.) By Johannes Zacharias. Octavo, paper, 260 pages, sixty-nine illustrations. Published by W. & S. Loewenthal, Berlin.

This is a very practical work on accumulators for traction and other purposes with especial reference to the use of storage batteries on automobile vehicles, boats, and for train lighting, etc. It is quite complete and contains tables of many practical and valuable data.

"Loricated" Electric Conduits.

The tubing manufactured by the Safety Conduit Company, Rankin Station, Pa., is attracting considerable attention in the electrical trade. It is designed for interior construction, and is made from regular standard gas pipe in thickness of wall and other dimensions. A tough, smooth coating of enamel is applied to both the inside and outside. The company claims that extraordinary protection is afforded by the use of this conduit for the reason that the enamel coating provides an additional insulating protection for the wire itself. The

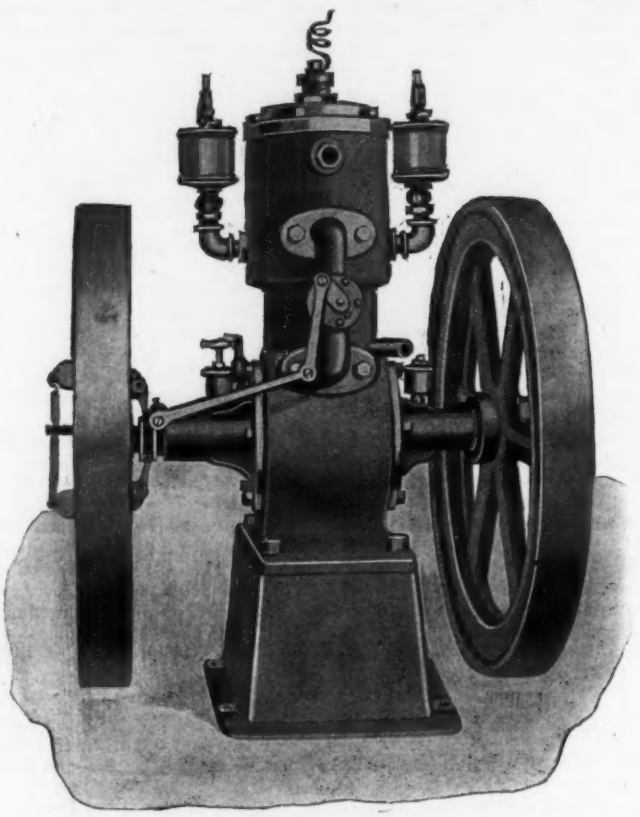
enamel is also a rust preventive, and does not allow any oxidization, even on the outside of the pipe. It is said to be sufficiently flexible to permit of bending the pipe into an elbow without cracking.

This tubing is of the class known as "unlined conduit," and has been approved by the National Board of Fire Underwriters. It has also been approved by other local boards, and in all places where it has been installed it is giving the best of satisfaction. During the last two months the company has installed this conduit in a number of fireproof structures in the Pittsburg district, and has besides taken the contract for the Washington City post office, into which building over 100,000 feet of the conduit will be installed. This latter contract was secured by the Southern Electric Company, of Baltimore. The Safety Conduit Company has ample facilities at its factory to supply large orders on short notice.

Gas and Gasoline Engines.

The steadily increasing popularity of gas engines for driving machinery of all kinds, and for the propulsion of boats, has led the Mianus Electric Company, Mianus, Conn., to place upon the market an engine of this class. This machine is said to be peculiarly fitted to supply the demand for an engine excelling in economy, safety and durability. The illustration shown herewith is of a 2½-hp Palmer stationary gasoline engine, of the two-cycle compression type, with an impulse at each revolution of the crank. The engine is provided with a fly-wheel governor, and is very compactly constructed.

The Mianus Company builds also gas and gasoline engines of the four-cycle type, having an impulse every other revolution. It manufactures engines from



2½-HP GASOLINE ENGINE.

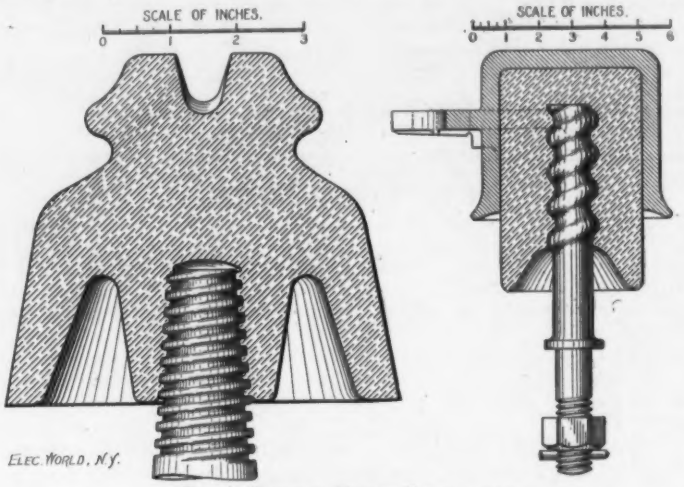
one to six horse-power, of both stationary and marine types, and can supply the castings and working drawings for the 1-hp and 2½-hp engines to those who wish to construct their own engines. The engines made by this company are readily adapted to the driving of dynamos for electric lighting, motor carriage work and the operation of printing presses. They occupy but little space and consume a minimum quantity of gas or gasoline.

A New Insulating Material.

An organic insulating material of very high resistance has been developed and is now being put on the market by the Etho Carbon Crete Insulator Company, 44 Broad Street, New York. This material, which has been in use for underground piping, etc., for many years, is composed of various insulating substances, bound together with asphalt, and moulded into appropriate shapes under pressure. The tests of this material recently made with a high tension testing transformer of one of the large electrical companies show quite remarkable results as to its insulation resistance. The insulator for overhead wiring shown to scale in the accompanying cross section view, weighing 5 pounds, withstood a test of more than 100,000 volts alternating between the wire channel and the pin, at which pressure the discharge jumped over the surface around the petticoat, as it will do in any insulator of the same dimensions or even through free air. The insulator was not punctured at all even after this surface discharge, and there was no apparent carbonization of the material.

The insulator appears to be quite non-hygroscopic, its surface when moulded under the pressure used (about 10 tons to the square inch for high tension work) having a high finish and apparently a slightly greasy nature, which prevents the deposition of moisture. One of the most valuable properties of the material, as compared with porcelain and glass, is its non-brittle character and its great strength. It has shown in testing machines a tensile strength of from 600 to 700 pounds per square inch, and a compression strength of from 5000 to 6000 pounds per square inch. It withstands without injury sharp blows which chip and crack the more brittle inorganic insulators.

Another valuable application for this material is the construction of insulators for conduit roads, a model devised for use on the Metropolitan Street Railway lines of New York City being shown in the illustration. Its value in this work is augmented by the fact that it does not have to be cemented either to the cap or the pin, as does the porcelain insulator now customarily used. The pin is simply inserted in a proper position in the cap, and the material moulded within the one and around the other, fastening them rigidly together. The material is not only impervious to moisture and unaffected

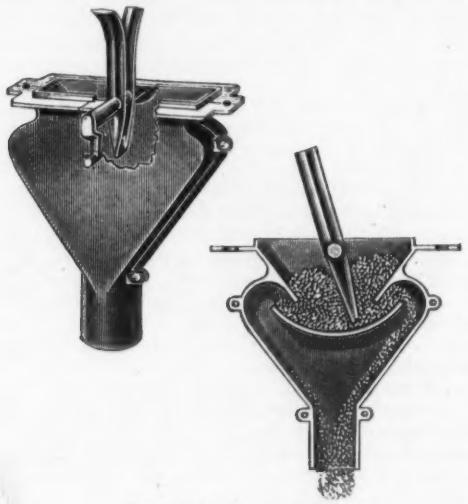


ETHO CARBON CRETE INSULATORS.

by atmospheric impurities or chemical reagents in the soil, but resists the action even of strong inorganic acids. It is, therefore, valuable for the construction of conduits, and owing to its strength (which compares favorably with that of cement) it makes a highly satisfactory duct. By joining lengths of such tubing together with hot plastic material of the same composition, the conduit may be made continuous and highly insulating in itself. Pipes of this material have been in use for sixteen years, and show no physical or chemical changes.

An Improved Sand Box.

The accompanying illustration presents a perspective view and a longitudinal section view of the Ham sand box, sold by the Electric Appliance Company, Chicago. Its construction will be readily understood by reference to the right-hand figure. The box has a funnel-shaped hopper into which the sand is poured. The sand drops onto the curved shelf, and is forced over the ends of the shelf by the reciprocating motion of the paddle. It then falls upon the rail through the spout. Above the paddle are two fingers, which stir the sand. The connecting rod for the operation of the paddle passes forward to the car platform, and is operated by a pin and bell crank lever or by a hand lever.



A SIMPLE SAND BOX.

The strokes of the foot or hand may follow each other so rapidly as to practically insure the application of a continuous, but small, stream of sand, which is advantageous in hill climbing. There is no waste of sand in the use of this box, and the flow can be regulated at will. The hopper inside of the car may be made of any form desired. If the space under the seats is enclosed, a square soap box or any other cheap form of construction may be employed. Small stones or other substances will not interfere with the operation of the box, but will freely pass through it. This sand box, we are informed, has received the approval of many prominent railroad men.

News of the Week

Financial Intelligence.

THE COMMERCIAL CABLE COMPANY has declared a quarterly dividend of 1¾ per cent., payable April 1.

THE COLUMBUS STREET RAILROAD reports gross earnings for February of $47,601, an increase of $4,807 as compared with the same month of last year, and net $24,263, an increase of $1,487.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, March 8, 1898.

THE STREET SURFACE railways in this city paid to the city during the year 1897 on account of percentages, franchises and car license fees, the sum of $351,883.16.

MR. W. C. HUBBARD, secretary of the Electric Arc Light Company, 150 Nassau Street, this city, has returned from a Western trip. Mr. Hubbard established several agencies for the Pioneer Lamp, and reports the business outlook as bright.

STORAGE BATTERY CARS were put in operation on March 3 on the Dry Dock, East Broadway and Battery Railroad. They are running on the cross-town line through Grand Street, from the North River to the East River. The batteries are placed under the seats, and are charged at the power house in Grand Street.

MR. GEORGE T. HANCHETT has opened an office at 123 Liberty Street, this city, where he will conduct a general electrical engineering business. Mr. Hanchett has facilities for conducting experiments, developing inventions, designing installations, etc., and with his experience, technical knowledge and energy he will no doubt build up a good business.

PLANS FOR THE TELEGRAPHIC TOURNAMENT to be held in connection with the Electrical Exposition at Madison Square Garden next May are being developed. It is said that Mr. Thomas A. Edison is taking great interest in the affair, and will make a phonographic record of the best transmissions, so that they may be reproduced at any time. The matter to be transmitted by the contestants will be the same as that used in the tournament in 1893. Mr. F. L. Catlin holds the highest record made in that time, namely, 248 words in five minutes.

FIELD RHEOSTATS HAVING SEPARABLE STEPS.—A patent was issued February 8 last to H. Ward Leonard, the claims of which cover field rheostats in which the insertion of resistance causes a reduction in the current strength, and in which the resistance is composed of separable unit steps and carried by a common support. Mr. Leonard states that he proposes to promptly institute suit against infringers. He claims that in addition to the present patent he is the owner of several other patents, the claims of which are also infringed by the field rheostats of the other manufacturers.

THE OFFICE OF SUPERINTENDENT OF FIRE TELEGRAPHS of New York City was abolished on March 4, and Superintendent J. Elliott Smith was dismissed in consequence. The work of the bureau will be carried on under the supervision of Chief Bonner. Mr. Smith has been in the telegraph department of the city for twenty years. He entered it as an operator, and rose in position step by step until he finally became superintendent. Fire Commissioner Scannell also removed Henry F. Blackwell, who had charge of the telegraph bureaus of Brooklyn and Queens Boroughs. Mr. Blackwell, however, was appointed an assistant to Chief Bonner.

FIRE on the night of March 4 destroyed the "South" exchange of the New York & New Jersey Telephone Company, in Brooklyn. Over 500 subscribers were thus cut off from telephonic communication. It is supposed that snow and ice on the telephone wires caused them to sag so that they came in contact with an electric light wire, resulting in firing the switchboard. At 7:30 o'clock the two operators in the exchange noticed electric sparks shooting in all directions from the switchboard, and a moment later the board was on fire; at the same time a blaze was seen at the top of a pole just opposite the telephone exchange. The damage to the telephone plant is estimated at $5,000.

THERE IS A TOUCH of the pathetic in the passing of the steam locomotives from the Brooklyn Bridge. When these useful little engines were thrown out of employment by the introduction of electric power for the switching of the bridge trains they were advertised for sale. But as the demand for steam locomotives of this class is limited and is growing more so every day, these engines have been a burden on the hands of the bridge trustees, taking up room that could otherwise be used very advantageously. Two engines were finally disposed of, and the third was sold a few days ago through the agency of a commission merchant for $1,955. The locomotives, it is stated, are to be used on a Mexican railroad.

NOW THAT the trolley service on the Brooklyn Bridge is in full and complete operation the effect upon the receipts of the bridge cable railway is such as to cause alarm in the minds of the bridge authorities. It is stated that Bridge Commissioner Shea is now considering the question of dismissing some of the cable railway employees and contracting the train service. The entire force, from ticket sellers to platform men, will likely be affected by the enforced reorganization of the service. It is stated that all the lines in Brooklyn which cross the bridge show a large increase in receipts. The Flushing and Graham Avenue line, which was formerly the poorest of all lines operated by the Heights Company, is said to be the most conspicuous in the improvements noted.

ELECTRIC CARS ON THE BOWERY.—Underground trolley cars were put into operation on Sunday morning last on that section of the Madison Avenue line below Astor Place to the Brooklyn Bridge. To complete the electrical equipment of this road the short section below the bridge entrance to the post-office remains to be finished. It is now possible to ride from the bridge to One Hundred and Thirty-fifth Street and Madison Avenue, and vice versa, on underground trolley cars without change and on one fare. The distance is about 8 miles. The smooth and easy running of the cars is delightful, as compared with the jerky motion of the cable cars and the elevated trains. The rolling stock and its equipment are of the best, and the accommodations and operation of the line are so superior that they are noticed by the most unobserving passengers.

THE FINANCIAL STATEMENT OF THE BROOKLYN BRIDGE for the month of February shows a falling off in receipts of $10,000, as compared with the receipts during the same month last year. Compared with the receipts of January, this year, the February income shows a loss of $18,000. These losses are no doubt due to the operation of the trolley cars on the bridge, which have absorbed the greater part of the cable car traffic. The trolley cars commenced running regularly across the bridge on February 16. Since that time an average of 2134 cars have crossed each day, and this number will probably soon be increased to 3500. It is stated that the increase in the trolley traffic is largely at the expense of the Brooklyn elevated railroads. The Commissioner of Bridges believes that the receipts of the bridge this year will be $600,000 less than the maintenance costs.

THE BILL TO REGULATE TELEPHONE CHARGES in New York State, which is now before the Legislature at Albany, it is reported stands a good chance of being passed. Mr. C. C. Shayne, president of the Merchants and Manufacturers Board of Trade, of this city, which body is co-operating with the New York Board of Trade and Transportation in the effort to secure a reduction in telephone rates, states that he is advised that the bill will be favorably reported to the Senate. A number of prominent merchants and manufacturers of this city are going to Albany on Thursday of this week, when the final hearing on the measure will be had. The bill in question has been before the Legislature for many years. It provides that the annual maximum charge for the use of a telephone shall be, in cities of 1,000,000 inhabitants and over, not to exceed $125 per annum; in cities of 500,000 inhabitants and less than 1,000,000, not to exceed $85 per annum; in cities of 100,000 and less than 500,000 inhabitants, not to exceed $48; in cities of 20,000 and less than 100,000 inhabitants, $36 per annum; in cities between 8000 and 20,000 inhabitants, $30, and in all places less than 8000 inhabitants, $27. It seeks to limit the profits of a telephone company to 10 per cent. on its capital, but provides means of affording relief in case the charges prescribed should prove to be unremunerative to any company.

SOUTHERN NOTES.

WASHINGTON, D. C., March 4, 1898.

THE CITY COUNCIL of Ocala, Fla., has decided to build a new electric light plant.

SUPERINTENDENT THOMPSON has made a special report to the Richmond, Va., Board of Fire Commissioners on the importance of placing the fire alarm and police telegraph wires underground.

THE CITIZENS OF AYLETT'S want the traction company, which contemplates building an electric line from Richmond to Newcastle Ferry, to extend the road 10 miles further so as to reach Aylett's, and, if thought desirable, to go through to Tappahannock, 20 miles beyond.

THE PROPERTY AND FRANCHISE of the Lynchburg Electric Company, including the street railway, has been sold at public auction under authority of the United States District Court, for $31,500 to Walter S. Johnson, president of the American Surety Company, New York.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., March 5, 1898.

THE FOURTH 5000-hp electric generator is now in position in the Niagara power house, and would now be in operation but for the slow work of building the governor. It will be used some time this month. Three more have been delivered, but the turbines are not yet finished.

THE BUFFALO TRACTION COMPANY has applied for a franchise to build lines on a large number of additional streets, mainly in the eastern part of the city, but there is the usual hitch in the City Council, and the progress promises to be slow. The new lines operated by this company are in a satisfactory condition.

THE BUFFALO GENERAL ELECTRIC COMPANY is just now smarting under a fine of $86 imposed by the city for alleged smoke nuisance at the Court Street station. The complaint is said to have been the work of a lawyer who failed to secure a position as attorney for the com-

pany. The best patterns of smoke consumers are in use at the station now, and hard coal is used almost exclusively to avoid smoke. A large sum has been expended for apparatus that failed to accomplish the desired results. The case will be appealed.

THE SCHOELLKOPF HYDRAULIC CANAL COMPANY is just finishing its large penstock at the power house in the gorge below Niagara Falls. This company is preparing to develop 32,000 horse-power when the power house is complete, and is already using well toward half that amount. The new penstock is over 300 feet long, and weighs 250 tons. After extending down the cliff 200 feet it proceeds into the building, a further distance of 100 feet. It is constructed of 200 pieces, and is 11 feet in inside diameter. By placing the machinery at the bottom of the gorge the company can do away with shafting.

BIDS WILL BE OPENED next week for the entire construction of the 19-mile line of trolley railroad that is to connect Buffalo with Hamburg and East Aurora. The specifications are for a ninety-day contract, and this is considered a much more easy task than it seems, from the fact that no large excavations or fillings will be required. One contractor made an effort to advance his chances by offering to do the work in sixty days. The company will furnish its own power, putting in four 250-kw generators. Twelve cars will be run at first, being of steam-car model in general and provided with four 35-hp motors. The transmission wire is to be No. 0000 copper, which fact is mentioned by the management to show that the equipment is to be of the best.

ST. LOUIS NOTES.

ST. LOUIS, Mo., March 4, 1898.

THE EAST ST. LOUIS ELECTRIC RAILWAY COMPANY has decided to extend its line to Madison, Granite City and all towns north of East St. Louis. This scheme has been under consideration for some time, but it was not until recently that the invitation to build the line was accepted by the company.

ANOTHER ELECTRIC RAILROAD INJUNCTION suit was filed in the Circuit Court at Belleville last Tuesday. The St. Clair County Turnpike Company wants the St. Louis & Belleville Electric Railway Company restrained from laying tracks on a portion of the road. The turnpike company claims that under a recent decision it has a right to exclude the rival electric road even though it has secured a franchise.

TEXAS NOTES.

SAN ANTONIO, Texas, March 1, 1898.

THE POSTAL TELEGRAPH & CABLE COMPANY has filed a document in the County Clerk's office of Travis County, Tex., executing a deed of trust to the Old Colony Trust Company, of Boston, Mass., to secure $2,000,000 in gold bonds. The document is a very long one.

THE ANNUAL MEETING OF THE DIRECTORS of the Southwestern Telegraph & Telephone Company will be held at Austin this week. It is stated that the most important proposition to come before the meeting is the consolidation of the North and South Texas districts, with offices at Dallas and Austin respectively, and the establishment of headquarters of the consolidated district at Waco, Tex.

MEXICAN NOTES.

MONTEREY, Mexico, March 1, 1898.

MR. CHARLES L. BONNEY, vice-president of the Chicago General Railway Company, has been spending several days in the City of Mexico. It is reported that he contemplates making investments in street railways in this country. He made a careful inspection of the street railway system of the City of Mexico.

MR. CHARLES HAGEMBECK, the owner of the Querendaro hacienda, in the State of Michoacan, is having an electric light plant installed on his property. It is stated that the plant will not only afford the necessary light for the place, but will also furnish power for several industries which are to be established on the hacienda.

SOME TIME AGO a concession for the establishment of an electric light plant for the City of Cuernavaca was granted to Dr. Ignacio Ortiz y Cordoba. The concession was for a period of twenty years. At present Dr. Ortiz y Cordoba is negotiating with capitalists to develop his concession. He has two propositions pending, one from Senor Escandon, of the City of Mexico, and the other from Mr. John W. Ebert, of Chicago, Ill. The latter has an option that expires March 20. Mr. Ebert states that in case he and his associates take up the business they will put in a plant that will cost about $50,000. The water power for the proposed plant will be obtained at Atlocumulco, situated only one mile from the city. The water at that place has a fall of 47 metres, with a minimum volume of 500 litros, or 125 gallons per second.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., Feb. 27, 1898.

THE CENTRAL LIGHT & POWER COMPANY, San Francisco, will soon let the contract for electric generating apparatus for a 600-hp increase of the capacity of electric lighting plant.

THE OPERATION of the Citizens' Traction Company's power plant has been suspended, as a result of the sale of the road to the San Diego Railway Company. The road will be operated as a part of latter company's system.

THE UNITED STATES GOVERNMENT has closed a contract with A. E. Brooke Ridley, of San Francisco, for a storage battery, consisting of 114 cells, having a capacity of 408 ampere hours, which is to be installed in Fort Selkirk, Alaska. Chloride cells are called for.

THE SERIES arc lighting plant in Golden Gate Park, San Francisco, is completed. Fort Wayne special type generators are driven by Union Iron Works engines. The installation is a duplicate of one at Girard College. John Roebling's Sons secured the contracts for the No. 6 lead covered mains.

A SHIPMENT of Bullock Electric Manufacturing Company's generators and motors recently arrived in this city in charge of Mr. Thomas J. Mullen, of Cincinnati, Ohio. This apparatus is now being installed in the new *Examiner* Building for lighting, driving presses, etc. The Bullock system will be used throughout, with Payne engines and Babcock & Wilcox boilers.

THE SACRAMENTO GAS, ELECTRIC & STREET RAILWAY COMPANY, Sacramento, Cal., recently let contracts amounting to about $20,000 for a steam plant, which is to be used in case of accident to the water power electric plant in Folsom, Cal. The new plant will have a capacity of 1000 horse-power. McIntosh & Seymour engines and Babcock & Wilcox water tube boilers will be used.

CANADIAN NOTES.

OTTAWA, ONT., March 5, 1898.

IT IS SAID that the St. Clair Tunnel Company contemplates converting the motive power for the tunnel from steam to electricity. The matter is understood to be under consideration by Mr. Joseph Hobson, of Montreal, chief engineer of the company.

THERE IS A MOVEMENT on foot to get an electric railway service for the Island of Orleans, near Quebec. It is reported that a charter will be asked for to construct an electric railway around the island. The power is to be obtained from Montmorency Falls.

THE PROGRESS which has been made in lighting by electricity is well illustrated by the statement contained in the report of the Commissioner of Inland Revenue for Canada, that there were 187 electric light companies registered in the Dominion under the inspection act during the year.

A NEW PROPOSITION for the supply of electric power to the city of Toronto has been made by the Georgian Bay Ship Canal and Power Aqueduct Company. The price quoted is 6 mills per electric horse-power per hour, the company agreeing to supply 2000 horse-power within two years from date of contract.

AT THE NEXT SESSION of the Manitoba Legislature a local company will ask for a charter to build an electric railway from Winnipeg to St. Andrew's Rapids, and through the municipalities of Springfield, St. Boniface, Kildonan, St. Paul's and St. Andrew's. The company also proposes to construct sawmills, boats, telegraph and telephone lines.

THE CORNWALL ELECTRIC RAILWAY COMPANY has submitted to the Town Council of Peterboro, Ont., a scheme for the construction of an electric railway from that town to Chemong and Lakefield. The company proposes to lease the Chemong and Lakefield lines from the Grand Trunk Railway, convert them into electric roads and take over the freight business. The cost is roughly estimated at $350,000.

IT IS UNDERSTOOD that Engineers Keating, of Toronto; Pearson, of New York, and Wanklyn, of the Montreal Street Railway, have visited the new Chambly Works, Quebec, with a view to reporting upon the feasibility of using that power for the Montreal Street Railway. The present cost of steam power is very nearly $42 per horse-power per annum, representing a total cost of $360,000 per annum. The Chambly people have, it is said, offered to furnish the company with power at $32.

WORK WAS BEGUN last month on the power house of the Hamilton Cataract Company, near Decew's Falls, Ont., and it is being rapidly pushed toward completion. The building is to stand within a few feet of the edge of the stream and above high water level, where the precipitous banks rise nearly 275 feet in height. When completed the power house will be 174 feet in length and 42 feet wide, with walls 30 feet in height. It is to be constructed throughout of steel, faced with brick and have cemented floors.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, Feb. 18, 1898.

A TROLLEY PROJECT.—The company now operating a steam tramway on the road from Paris to Arpagon, a distance of 30 kilometres (19 miles), has applied for permission to substitute an overhead trolley system for the section from Paris to Antony, a distance of 11 miles. A public hearing at the mairies of the chief places affected is now in progress to determine if the rights asked for shall be granted.

AFFAIRS OF THE COMPAGNIE ELECTRIQUE DU SECTEUR DE LA RIVE GAUCHE.—Apropos of this company, which has its station at Issy, at the entrance to the city on the left bank of the Seine, it is of interest to note the numerous very important projects it has now in preparation or has already carried out. Beside being established in that great part of Paris lying to the left of the Seine, this company has already made efforts to obtain concessions for electric lighting in the suburban towns of Neuilly, Boulogne, Issy, Vannes, etc. After an arrangement with the Creusot Company it has asked for a franchise for a tramway to serve the grounds of the exposition of 1900. In addition it has sought a franchise for an electric tramway running from the Bois de Boulogne to the Bois de Vincennes, and passing around Paris through Issy, Vannes, Malakoff, Montrouge, Bicetre, Ivry, Alfort, Charenton, Sainte Maurice and Sainte Mandé. These places comprise a total of more than 200,000 inhabitants. Finally the company has just contracted for the extension of the Orleans railway to the Quai d'Orsay. It will furnish current for lighting the work, and for the motive power of the boring machines for driving the tunnel, for the electric drainage pumps and the brick mills, etc., and possibly for traction purposes also. For these uses

alternating current at 2000 volts is transformed, through an Alioth rotary transformer of 90 kilowatts, into direct current at 220 volts, to work the various motors, etc., employed on the works and for charging accumulators. Work will be begun by April 1, and will continue night and day for eighteen months or two years until finished. None of these projects have interfered with the lighting business of the company in its district to the left of the Seine, for during the two years since it begun operations about 100,000 lamps have been connected. In order to provide power for the new enterprises the station at Issy is to be immediately enlarged.

A GREAT TRACTION PROJECT.—The Compagnie Generale des Omnibus fully realizes the danger in which, despite its power, it now finds itself, and is making immediate preparations to modify its service. It speaks of metropolitans, of electric tram lines on all sides, and proclaims aloud its intentions, seeing that its franchise is about to expire, and that it must regain lost ground. It now proposes to establish, at its own expense, mechanical traction on a first installment of fifteen tramway lines, so selected that the total expense will not exceed 25,000,000 francs ($5,000,000). This sum will be procured by bonds maturing in 1910, at the termination of its contract with the city. Further, it offers to apply mechanical traction to a second installment of ten lines if the city of Paris will pay the principal of another issue of bonds, to the extent of $3,000,000, also maturing in 1910, necessary for their construction. The company agrees in this case to establish mechanical traction on all of its lines of tramways; to establish five new omnibus lines and fourteen new tram lines; to turn over to the city two-thirds of all profits accruing beyond those necessary to the payment of a 7 per cent. dividend; and, finally, to reduce the fare in its vehicles to 20 centimes (4 cents). The method of traction adopted is to be by accumulators. The Omnibus Company has already opened negotiations with the Parisian electric light companies, notably with the company controlling the lighting on the left bank of the Seine. To comply with the requirements of the first part of the programme above this lighting company would have to furnish the necessary current for the tramway to Montrouge and to the Gare de l'Est, which is the line having the heaviest travel, and to the tramway from Vaugirard to the Gare du Nord. It would be rather an important contract for the company, since it is estimated that the lines mentioned will consume no less than 4,000,000-kw hours annually. The accumulators would be charged in those times of the day when the demand of the station for lighting current is small.

TIDES AS MOTIVE POWER.—A very interesting experiment upon the utilization of the power of the tides for driving machinery has just been made at the little port of Ploumanach, on the northern coast of France. This sort of utilization can be easily accomplished at points on the deeply indented coast of Brittany, where there are a large number of natural tidal basins, and where the difference in the daily tidal level is considerable, frequently reaching 12 metres (39 feet). The object of the experiment was to generate electric current from this tidal power for lighting purposes through the use of a dynamo and a battery of accumulators, the latter being necessary on account of the intervals of slack water. An old grist mill was used as the generating station. A natural pond, shaped like an isosceles triangle and having its base toward the shore, is separated from the sea by an embankment or causeway of ancient date, 120 metres (385 feet) long. The pond is about 800 feet long, and has an area of about 3¾ acres. Gates of a very ingenious kind have been constructed in the embankment. At low tide they are uncovered by the receding water, their planes making acute angles with the surface of the sea; the weight of the water in the ponds holds them securely closed until they are again opened by the rising tide being above the level of the pond. At high tide the water thus fills the pond to its own level, and as the tide recedes the gates automatically shut and prevent the escape of the impounded water. The gates are furnished with soft rubber gaskets, and seat themselves watertight. The higher the head of the retaining water the greater the pressure on the gates and the tighter the fit in consequence. The leakage is said to be very small. On account of the automatic nature of the gates they require no attention, the pond filling itself automatically twice a day. The dike which holds the pond is 8 metres (26 feet) high, but all of the head thus furnished is not available on account of the pond serving also as a storage and breeding place for oysters, mussels and lobsters, which require to be kept covered with water. A sluice gate is provided, however, by which the pond may be completely emptied. The fall used is from 25 to 28 feet, races leading the water to ordinary water wheels. Hitherto only a single wheel has been used. driving a Pictet sulphurous acid ice machine, and making 240 kilos (530 pounds) of ice at a charge, or 1160 pounds a day. Now a dynamo is installed, and the water wheels of the old grist mill are to be replaced with more perfect apparatus. Two wheels are used, each capable of furnishing 50 horsepower at the full head and 20 horse-power four hours after the discharge of the pond is begun. The whole expense of generating thus about 1500 to 2000-hp hours a day is insignificant. One man takes care of the fish pond and the power station, and the total expense for the power generated is not more than 10 francs ($2) a day.

General News.

New Incorporations.

THE INTERSTATE TELEPHONE COMPANY has been incorporated at Sioux Falls, Ia., by C. O. Bailey, J. H. Voorhees and J. W. Carter, with a capital stock of $10,000,000.

THE CITIZENS ELECTRIC COMPANY, Eureka Springs, Ark., has been formed with a capital stock of $23,000. The incorporators are W. M. Duncan, A. R. Sayle and L. P. Badger.

THE JACKSON TELEPHONE COMPANY, Cape Girardeau, Mo., has been organized with a capital stock of $2,500. The incorporators are Samuel Hitt, Lee Hart, J. W. Miller and others.

THE WAPPLER ELECTRIC CONTROLLER COMPANY, New York, N. Y., has been incorporated with a capital stock of $5,000 by R. Wappler, J. C. F. Jacoby, F. H. Wappler and Charles Foyer.

THE WINSBORO ELECTRIC LIGHT & POWER COMPANY, Winsboro, Tex., has been formed with a capital stock of $3,000. The incorporators are K. G. Andrews, C. H. Morris and W. T. Whiteman.

THE EUREKA TELEPHONE COMPANY, Eureka, S. Dak., has been organized with a capital stock of $2000. The incorporators are C. N. Herried, J. L. Zeitlow, C. L. Parkhurst, E. C. Kennedy and others.

THE STANDARD TRACTION COMPANY, Philadelphia, Pa., has been formed with a capital stock of $1000. Among those interested are M. L. Young, E. F. Morse, W. S. Doran, J. H. Reber and W. F. Sullivan.

THE JAMESTOWN ELECTRIC LIGHT & POWER COMPANY, San Francisco, Cal., has been incorporated by William A. Nevills, John Ballard, W. H. Martin, W. Grant and R. B. Carpenter. Capital stock, $500,000.

THE ELECTRIC GOLD DREDGING COMPANY, New York, N. Y., has been incorporated with a capital stock of $100,000. The incorporators are C. H. Treat, C. A. Hitchcock, J. H. Killaugh and O. A. Vanderlyn, all of New York.

THE NEW KENSINGTON STREET RAILWAY COMPANY, Pittsburg, Pa., has been organized to operate a road about 2 miles long. The directors are T. A. Mellon, W. L. Mellon, F. M. Ross and C. T. Marsh. Capital stock, $12,000.

THE CHESTER COUNTY TELEGRAPH & TELEPHONE COMPANY, Oaks, Montgomery County, Pa., has been formed with a capital stock of $30,000. It will run its lines in Chester, Montgomery, Bucks, Lancaster and Delaware counties.

THE KNOX TELEPHONE COMPANY, Knox, Ind., has been incorporated with a capital stock of $4500. The purpose of the company is to establish exchanges in Starke, La Porte, St. Joseph, Marshall, Fulton, Pulaski and Jasper counties.

THE WEST PENN TELEPHONE COMPANY, Washington, Pa., has been formed with a capital stock of $12,000. The directors are J. G. Hanna, D. K. Irwin, E. E. Mumper, J. M. Bemis, O. M. Henderson, J. Y. Hamilton and Joseph McElroy.

THE TIFFIN, FOSTORIA & EASTERN ELECTRIC RAILWAY COMPANY, Tiffin, Ohio, has been formed with a capital stock of $175,000. The purpose of the new company is to build an electric railway and a telephone line from Tiffin to Fostoria.

THE COLUMBUS ELECTRIC COMPANY, Columbus, Ohio, has been formed to supply power and light. The incorporators are Irvin Butterworth, W. F. Douthirt, C. S. Ritter, Arthur E. Bliss and Irving M. Selige. The capital stock of the new company is $750,000.

THE MERCED FALLS ELECTRIC POWER COMPANY, Merced, Cal., has been incorporated with a capital stock of $100,000. The directors are James G. Ruddle, Snelling; E. D. N. Lehe, Stockton; James T. Peck and J. D. Bradley, Merced, and C. E. Green, San Francisco.

THE EWING PASSENGER RAILWAY COMPANY has been incorporated at Trenton, N. J., to build an electric road in Ewing Township, a suburb of Trenton. The incorporators are H. C. Moore, Robert S. Woodruff, B. Frank Abbett, Peter E. Hurley and others. Capital, $12,500.

THE TRIUMPH LIGHT, HEAT & POWER COMPANY, Camden, N.J., has been organized with a capital of $200,000. The incorporators are George A. Banks, R. Linwood Martin, Robert B. Kee and James W. Moore, of Philadelphia, and Alfred J. Lucas, of Gibbsboro, N. J.

THE MYERSDALE ELECTRIC LIGHT, HEAT & POWER COMPANY, Myersdale, Pa., has been formed with a capital stock of $10,000. The incorporators are Hugo Lorentz, Frank Rosenberger, Thomas Rees, Arthur Lorentz and S. D. Livengood, Myersdale, Pa.; Harvey M. Berkley and J. A. Berkley, Somerset.

THE MINNEAPOLIS & ANOKA ELECTRIC SUBURBAN RAILWAY COMPANY has been incorporated at Minneapolis, Minn., with a capital stock of $100,000. Those interested are Henry Lee, I. A. Coleman, A. R. Giddings, Theodore and John Coleman, John Dunn, Hiram Thornton, O. L. Cutter and Frank Hart.

THE SHERWOOD CAR FENDER COMPANY, Jersey City, N. J., has been formed with a capital stock of $400,000. The incorporators are Everett Brown, Penn Yan, N. Y.; E .G. Maturin, East Orange, N. J.; A. C. Scism and C. H. Bonner, Brooklyn, and J. J. Curtis and Earl Sherwood, Honesdale, Pa.

THE GERMANTOWN & FAIRMOUNT PARK STREET RAILWAY COMPANY has been incorporated at Philadelphia, Pa., with a capital stock of $80,000. The incorporators are Charles E. Morgan, W. R. Wister, William G. Warden, J. M. Bacon, S. T. Bodine, Richard Ashhurst, Joseph Bushnell and William Wharton.

THE WARREN-MEDBERY COMPANY, Sandy Hill, N. Y., has been formed for the purpose of manufacturing electrical supplies. The directors are Horace J. Medbery and S. C. Medbery, of Ballston Spa, N. Y.; H. B. Warren, of Yonkers, and W. H. Cunningham, H. E. Tidmarsh, Lincoln Paris, and G. W. Wait, of Sandy Hill. Capital stock, $25,000.

THE WILMINGTON & CHESTER TRACTION COMPANY has been incorporated at Trenton, N. J., with a capital stock of $2,000,000. Henry C. Moore, president of the Trenton Passenger Railway Company; Henry A. McCarthy, of Ridley Park, Pa.; G. Richard Nichols, of Germantown, Pa.; Clarence Sill, of Darby, Pa., and Charles Martindale, of Camden, are the incorporators.

THE QUEENS BOROUGH ELECTRIC LIGHT & POWER COMPANY, Far Rockaway, L. I., has been formed to operate in Kings, Queens and Suffolk counties. The directors are Van Wyck Rossiter, D. H. Valentine, Royal C. Peabody, T. S. Williams, of Brooklyn; Frank McGovern, of New York; Joseph C. Biglin, of Far Rockaway; I. M. Sutton, of Flushing, and H. Hobart Porter, Jr., of Lawrence.

THE NEW BEDFORD, MIDDLEBORO & BROCKTON STREET RAILWAY COMPANY, Fall River, Mass., has been incorporated with a capital stock of $325,000. The directors are Rufus A. Soule, William M. Butler, John J. Whipple. The route of the proposed road is from Clarke's Point, New Bedford, through Freetown, Lakeville and Middleboro to Bridgewater, where it will join the Brockton, Bridgewater & Taunton line, making a line 32½ miles long.

THE TELEGRAPH AND TELEPHONE.

TRENTON, N. J.—A bill to limit telephone charges has been introduced in the Senate.

BRISTOL, TENN. A new telephone line has just been completed between Jonesboro and Blountville.

CLEVELAND, OHIO.—The Home Telephone Company will extend its lines so as to take in all the nearby towns.

WILLOW, MICH.—The Citizens Telephone Company's line will be extended from New Boston to Romulus and Wayne.

AUSTIN, MICH.—The Austin Telephone exchange and all its connections have been sold to the Northwestern Telephone Company.

ST. PETER, MINN.—A movement is on foot to organize a telephone company to build a line between St. Peter and Winthrop, with stations at Traverse, Norseland and New Sweden.

YOUNGSTOWN, OHIO.—The Board of City Commissioners has decided that telegraph and telephone wires and cable shall be placed underground between Westlake's Crossing and the East Federal Street bridge.

TECUMSEH, NEB.—The Nebraska Telephone Company will establish an exchange in this place, and will commence work on the same at once. Efforts have been made by citizens many times to establish a system, but each effort failed.

SHELBYVILLE, IND.—A petition has been presented to the Indianapolis authorities for a franchise for the New Telephone Company of Indianapolis. The stockholders of the Mutual Telephone Company are assisting the new company in securing the franchise.

BARNESVILLE, OHIO.—The Barnesville Telephone Company has transferred to the Central District & Printing Telegraph Company, of Pittsburg, all its property, contracts and franchises. The latter-named concern will carry out all the contracts of the Barnesville Company.

OSHKOSH, WIS.—The Wolf River Telephone Company proposes to connect with the Oshkosh Northwestern Telephone Company by extending its line through Winneconne and Omro. Franchises through the villages named will be asked for. The company offers a rate of 10 cents from Omro to Oshkosh.

MARSHFIELD, WIS.—A fifteen-year franchise has been granted to R. L. Kraus and K. W. Doege to build and maintain a telephone exchange in this place. The enterprise will be conducted on the co-operative plan, and rentals will not exceed $1 per month for residences and $2 per month for business purposes.

JACKSON, MICH.—The Interstate Telephone Company of Mississippi is being organized to construct a line from Hattiesburg to Gulfport, and also from Hattiesburg to Meridian. The line will be extended eventually to Columbia by way of Williamsburg. Hattiesburg will be the headquarters of the new company.

ELECTRIC LIGHT AND POWER.

NEWARK, N. J.—It is reported that the Kearney Electric Light Company has been purchased by the Newark Company.

PHILADELPHIA, PA.—A receiver has been appointed for the Pitman Grove, Glassboro & Clayton Electric Light Company. The plant is worth $10,000.

FARGO, N. DAK.—Valley City's new electric light plant has already proved inadequate to the necessities of that thriving city, and another dynamo will be put in.

GETTYSBURG, PA.—Newville wants an electric light plant of its own, but some citizens think the expense would be too great, and have asked the court for an injunction.

CONSHOHOCKEN, PA.—The Town Council of Norristown has voted to build and operate its own electric light plant. The Wyoming Mills have been leased for the purpose.

WESTCHESTER, PA.—The municipal electric lighting plant contract has been awarded to the Falkenau Engineering Company, of Philadelphia, at $41,000. There were seven other bidders.

CHICAGO, ILL.—Four thousand dollars has been appropriated for an extension of the municipal street electric lighting plant in the Eighteenth Ward, the funds to be paid out of receipts from street car license fees.

NORFOLK, VA.—The Roanoke Electric Light & Power Company has joined hands with the Roanoke Street Railway Company, and both organizations will have a single charter. The service will be extended to take in nearby towns.

COLUMBUS, OHIO.—Professor Thomas, of the Ohio State University, has made a patient investigation, and finds that the Columbus Electric Light & Power Company, instead of furnishing the city arc lights of 2000 candle-power at $74,000, as required by contract, is really furnishing lights of only 1200 candle-power. If this be true the company has forfeited its franchise and is liable in damages.

DOYLESTOWN, PA.—An ordinance authorizing a private company to operate an electric light plant in Perkasie has passed first reading. The lights are to be ready by the middle of June, and will be furnished at these prices: $625 per year for twenty-five arc lights of 1000 candle-power, lights to be burned all night and every night; 30 cents per night for private arc lights, and one-half cent per hour for incandescent lights.

PITTSBURG, PA.—A Pittsburg syndicate is trying to buy the Valley Flouring Mill property near Grafton, W. Va., with a view to erecting a big electrical establishment. The best water power in the State is at the Valley Falls.

MILWAUKEE, WIS.—A new company has come into possession of the plant formerly owned by the South Milwaukee Light & Power Company. They ask for a ten-year franchise, with a contract to furnish 40 arc lights at $80 per light; additional lights $70 each, under the Philadelphia moonlight schedule. The Council will undoubtedly agree.

THE ELECTRIC RAILWAY.

AUBURN, N. Y.—It is rumored that the Auburn Interurban Electric Railroad will lease the lines of the Auburn City Railway Company.

OSHKOSH, WIS.—The authorities have granted the Citizens Traction Company the right to operate street cars to the new summer park and theatre.

WILKESBARRE, PA.—The Wilkesbarre & Northern will substitute electricity for steam on the road to Harvey's Lake before the summer trade opens.

PITTSBURG, PA.—A number of Beaver capitalists propose to build a road from Rochester to North Sewickley Township, near Ellwood, a distance of 5 miles.

BALTIMORE, MD.—Delegate Halbert has introduced a bill in the House providing that adult passengers not provided with seats in street cars shall pay only 3 cents car fare. Children who have to stand are to pay nothing.

MIDDLETOWN, N. Y.—The Port Jervis trustees have granted the application of the electric railroad company to extend its line from West Main Street to the Delaware River. The company proposes to build the line through to Milford, Pa.

NEW YORK CITY.—A bill has been introduced in the Legislature prohibiting street railways in Brooklyn from collecting tickets or more than one half fare from any passenger unless he is provided with a seat immediately upon entering a car.

CHICAGO, ILL.—Roswell Miller, president of the Chicago, Milwaukee & St. Paul Railroad, stated that it has decided to equip the Chicago & Evanston Division of the road with electric power. This branch of the system is devoted exclusively to suburban service.

NEW HAVEN, CONN.—A movement is on foot here to secure a system of transfer coupons from one street railway to another to allow a passenger to go anywhere in the city on one fare. If the companies ignore or refuse the matter will be carried to the Legislature.

ALBANY, N. Y.—The trustees of Bath-on-the-Hudson and the citizens' committee of that town are trying to get the Albany railway to extend its lines into the village. A numerously signed petition setting forth the advantages will be sent to the railway officials.

CHESTER, PA.—The Chester Traction Company has begun survey for the trolley connection between Marcus Hook and Wilmington. The right of way to the State line has been granted. Work will be started in the early spring. The syndicate which now has control of the Chester Traction and Wilmington lines is anxious to have a trolley line through between Philadelphia and Wilmington. Other improvements are contemplated.

LEGAL NOTE.

A JUDGMENT for a little over $3,000 has been entered in New York against the Excelsior Electric Company and in favor of the General Electric Company. Mr. H. D. Fuller, president of the Excelsior Electric Company, says that it is the result of a suit growing out of a settlement made between the companies some time ago, which was not satisfactory to the General Electric Company. The Excelsior Electric Company thinks the judgment should not have been given against it, and has appealed the case.

PERSONAL NOTES.

MR. M. E. HERSHEY, general manager of the Harrisburg Foundry & Machine Works, Harrisburg, Pa., on February 1 severed his connection with that concern.

MR. W. R. FLEMING, of the firm of W. R. Fleming & Co., New York, has accepted the position of vice-president and general manager of the Harrisburg Foundry & Machine Works, Harrisburg, Pa. Mr. Fleming assumed his new duties on February 1 last.

MR. JAMES F. CUMMINGS, president of the Armorite Interior Conduit Company, Pittsburg, Pa., has, we understand, decided to give up the active management of that concern and devote his entire time and attention to his new conduit and conductor system, which will be placed upon the market in the near future.

Trade and Industrial Notes.

THE A. A. GRIFFING IRON COMPANY, Jersey City, N. J., has just issued a new catalogue, describing its full line of Bundy specialties. A copy of the catalogue can be obtained on application.

THE BALL ENGINE COMPANY, of Erie, Pa., builder of the Ball engine, has been operating its works day and night since September last, on account of the great demand for its engines for electric light and power purposes.

MR. J. B. ROONEY, Walpole, Mass., is offering for sale ten new electric street cars, with complete electrical equipment; also eight second-hand cars,

fully equipped. He also has a snow plow, a rail bender, a 125-hp engine and a 200-hp boiler to dispose of.

MR. A. H. WOODWARD, president of the International Register Company, Chicago, Ill., is feeling very much pleased at the prosperous condition of the register business. His company has as many orders in hand as it can fill for months, with prospects of larger ones to come.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., has just issued a neat little catalogue and price list of Espersen adjustable lamp shades, Klemm portable desk lamps and Dale bracket lamps, all of which are handled by this company. The various styles of lamps are illustrated.

THE WARREN ELECTRIC COMPANY, of Chicago, Ill., has passed into the hands of a receiver. For the information of those who might be misled by the similarity of names, we would state that this company has no connection with the Warren Electric Manufacturing Company, of Sandusky, Ohio.

THE DIAMOND STATE TUBE COMPANY, Ellsmere, Del., has recently put on the market a waterproof and fireproof tubing for electrical installation which is meeting with ready sale. The company claims that this tubing is superior to anything heretofore used, and cheaper. Samples and prices can be had on application.

THE CARBORUNDUM COMPANY, Niagara Falls, N. Y., in a little pamphlet just issued tells what carborundum is thought of by the many users of this substance. The expressions of opinion are given in letter form, and the writers thereof seem to be of one mind regarding the subject. It is needless to say that the opinions are decidedly favorable

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, in a catalogue just issued describes its switchboard and portable voltmeters, ammeters, wattmeters, ground detectors and other measuring instruments. These different instruments are illustrated and diagrams are given showing the method of connecting them to circuits.

THE ELECTRIC STORAGE BATTERY COMPANY has opened an office at 914 New England Building, Cleveland, Ohio, to afford greater convenience in the handling of its growing business in that territory. The office has been placed in charge of Mr. W. O. Knudsen, who was until recently connected with the New York office of the same company.

THE MASON TELEPHONE PAY STATION COMPANY, Ludington, Mich., manufactures an automatic telephone toll collector for pay stations which is said to be a reliable instrument, and one that does not infringe in any way on other patents. The instrument is designed for use in all public places, such as depots, hotels, restaurants, drug stores, etc., without attendant.

THE BRISTOL & PLAINVILLE TRAMWAY COMPANY is erecting near Plainville, Conn., a new, substantial steel bridge, having a span of about 90 feet. The bridge has been designed with a view of being a permanent structure, well able to take care of the increasing and heavy traffic of the road. It has been furnished and is now being erected by the Berlin Iron Bridge Company, East Berlin, Conn.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has received an order from the United States Government for twelve electric motors to be used in the Brooklyn Navy Yard. The motors range from 10 to 20 horse-power, and are wound for 220 volts. They will be used to drive machinery in the yard. The Bullock Company's factory has been working day and night to fill this order, which is a rush one.

THE HARRISBURG FOUNDRY & MACHINE WORKS, Harrisburg, Pa., contemplates a considerable increase in its facilities for manufacturing automatic engines for electric service, and it intends adding several new lines of engines, so as to broadly cover the whole field of steam engine practice. It is understood that the company will rebuild its entire plant upon a plan and scope which place it in a superior position for the manufacture of its well-known machinery.

MESSRS. HUEBEL & MANGER, Brooklyn, N. Y., state that they are now making more iron box bells than ever before. The demand for high-grade bells is increasing, and the fact that this firm's goods are so well known and are carried in stock by all the leading supply houses in the country is unquestionably the reason for this satisfactory condition of things. By reason of their improved facilities and increased output, Messrs. Huebel & Manger are enabled to produce a superior bell at less cost than was possible a few years ago.

MR ALFRED A. THRESHER, of the Thresher Electric Company, Dayton, Ohio, was in New York on business for several days during the week. Mr. Thresher's company has recently secured sufficient orders to keep its establishment busy for some months, among them being one for 110-kw direct-connected generator and forty-three motors for the operation of the printing presses of the Methodist Book Concern, Cincinnati, Ohio. This is said to be the first large printing establishment in the West to be run by direct-connected motors.

MESSRS. ZIMDARS & HUNT, 127 Fifth Avenue, New York, have issued two very handsomely gotten-up catalogues of their electric light and power specialties. Catalogue A is devoted to knife switches and switchboard fittings, and Catalogue C to automatic switches and motor starters. The illustrations of the many devices are of high order, and the mechanical work involved in the production of the catalogues is of the best quality. Brief specifications of the various instruments accompany the illustrations. The paper covers of the catalogue are an excellent imitation of marble.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, will in about two weeks commence the erection of its new plant in Norwood, Ohio, about 4 miles from Cincinnati. The contract for the steel structural work has been let, and bids on engines, boilers, etc., are now being received. This plant will consist of a large machine shop, brass foundry, pattern and office building and power house, and will have four or five times the capacity of the present plant. The company is now ordering many new machine tools, and its shop will contain the finest machinery in the market, as well as the latest electrical apparatus. In nearly all cases each tool will have a motor directly attached to it, thus reducing belting and shafting to a minimum. It is the desire of the company to make this a model plant, and the shop will no doubt contain many new and interesting features.

A SECOND EDITION of the bulletin on arc lighting dynamos has been issued by the Western Electric Company, Chicago, Ill. On the cover is an illustration of a dynamo installed in an electric light plant in Detroit, and inside there are six half-tone engravings which show in detail the various parts of the dynamo. An illustration of an arc light switchboard, as built by the Western Electric Company, is also given. A complete table is incorporated in this bulletin, giving the number and type of dynamos, the ampere capacity, the size of pulley, the height of the machines, the floor space and the approximate shipping weight. The Western Electric Company has also issued two catalogues of lamp parts, one relating to parts of that company's constant potential arc lamp, and narrow frame, double carbon high tension Scribner lamp, and the other to parts for high tension single carbon arc lamps.

AN ANALYSIS of the list published in The Electrical World of February 19, giving the names of firms and individuals who have secured space for exhibits at the Electrical Exposition to be held at Madison Square Garden, New York, during the month of May next, discloses many interesting facts. In the first place the high character of the names and their number give a positive assurance of the success of the great enterprise, and in the second place the active demand for space in the early preliminary stages in the development of the plans gives rise to the belief that the show will be successful from the standpoints of extent and variety. The ambition of the projectors of the exposition to make the affair a success in every particular is therefore likely to be fully realized. The incidental educational features of the exposition will, no doubt, be drawing cards, and will enhance the popularity of the show.

THE WALKER COMPANY will shortly install two six-pole 100-kw lighting generators in the Metropolitan Museum of Art in New York. The Presbyterian Hospital has also placed an order with the company for a 100-kw generator and switchboard. A Walker alternator, three-phase, sixty cycles, for lighting and power, has been purchased by C. Burkhart, of Hudson, Wis., while the Los Angeles Traction Company, of Los Angeles, Cal., has ordered a 500-kw railway generator of the belted type and a generator panel for the switchboard. Among the electric railway equipments recently ordered may be mentioned ten double 3 S equipments, with type S controllers, sold to the Erie Construction Company, for the Buffalo Traction Company; three double 40-hp equipments, with S controllers, to Isaac A. Walker & Son, for the Quakertown (Pa.) Traction Company, and two double 3 S equipments for storage battery motor cars to S. M. Fisher, for the Patton Motor Company. The Walker Company states that the type "S" solenoid blow-out controller is the most popular one it has ever placed on the market. The controller departments of its factories are turning out very large numbers of the type "S" apparatus.

Business Notice.

A HANDSOME METAL PAPER CUTTER AND BOOKMARK COMBINED.—Sent free of postage under sealed cover on receipt of 10 cents in silver or stamps. The latest, best and most serviceable adjunct of every library and office. Address George H. Heafford, 410 Old Colony Building, Chicago, Ill.

Illustrated Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 1, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

599,692. ELECTRIC SWITCH; G. Doyle, Brookline, Mass. App. filed August 14, 1896. In an electric switch, the combination with a removable member comprising conducting pivoted blades, and a tie-bar connecting said blades together, of a handle attached to said tie-bar to move therewith, a locking device to engage said tie-bar and secure said movable member in its closed position, a releasing device operated by movement of the said handle, and means to move said movable member into its open position when unlocked. (Issued Feb. 22, 1898.)

599,713. PNEUMATIC TRAVELER FOR PIPES OR CONDUITS; L. H. Kohler, Milwaukee, Wis. App. filed June 16, 1897. A pneumatic traveler for a pipe or conduit comprising a flexible disc or discs, a head-block and a tail-block of less diameter than the disc or discs, between which blocks the disc or discs are clamped, and guides projecting from a block adapted to bear against the wall of the pipe or conduit in which the traveler is employed.

599,718. PLATE FOR ACCUMULATORS; W. Majert, Grunau, Germany. App. filed August 19, 1897. An accumulator plate comprising a plate or bar having corrugations therein of substantially the shape of the half of a cone when divided on the line of its axis.

599,742. APPARATUS FOR VISIBLE SIGNALING; L. Sellner, Vienna, Austria-Hungary. App. filed March 28, 1896. A signaling element consisting of a cylindrical lantern having superposed uninterrupted light-transmitting zones, a constant source of light in the plate of each of said zones, a circular shutter interposed between each zone and its source of light, a shifting mechanism for each shutter, and means for operating said shifting mechanisms independently of each other, whereby one or the other of the two sources of light can be continuously or intermittently exposed, or both sources alternately exposed.

599,781. CURRENT COLLECTING DEVICE; L. Gutmann, Peoria, Ill. App. filed April 26, 1897. The combination in a brush for dynamo electric machines, with a gauze body portion formed of conducting material, of a superposed stratum of supplemental conducting leaves of laminæ and an electrical union joining said conductors at one extremity of the brush.

599,789. TRANSFORMATION OF ALTERNATING CURRENTS INTO DIRECT CURRENTS; A. Muller, Hagen, Germany. App. filed July 30, 1897. The combination with an alternating current charging circuit, a discharging circuit, and suitable changing appliances interposed in said circuits, of a shunt circuit, means for electrically connecting the same with the circuit, before the connection between the latter and the discharging circuit is interrupted by said circuit-changing appliance, and an electro-receptive device in said shunt circuit capable of deveоднoping a counter E. M. F. substantially equal to the E. M. F. of the alternating current during such period of interruption, so that the alternating current circuit will at the moment of interruption be without current.

599,791. ELECTRIC MOTOR; O. H. & A. F. Pieper, Rochester, N. Y. App. filed October 17, 1896. In a shunt wound electric motor, the combination with the main switch for controlling the current to the field and armature, and resistance between one of the leading-in wires and the machine circuits, of a switch actuated by the main switch and contacts co-operating therewith, arranged and operating to short circuit the field and armature before breaking the main circuit by means of the main switch.

599,803. RHEOSTAT; S. H. Short, Cleveland, Ohio. App. filed May 14, 1897. In a rheostat for street railway motors, a spider having radial arms adapted to receive the resistance material in spiral convolute layers therebetween, and means for attaching the motor circuit terminals to such resistance material.

599,804. METHOD OF AND MEANS FOR CONTROLLING ELECTRIC MOTORS; S. H. Short, Cleveland, Ohio. App. filed May 19, 1897. The method of controlling motors which consist in maintaining a substantially constant or uniform accelerating current until the desired speed has been attained, and thereafter reducing said current, thereby maintaining a uniform speed.

599,805. METHOD OF AND MEANS FOR CONTROLLING ELECTRIC MOTORS; S. H. Short, Cleveland, Ohio. App. filed October 21, 1897. The method of controlling motors which consists in varying the windings in the motor field to maintain a substantially uniform accelerating current and thereafter reducing the motor current to a point such as to maintain a uniform speed.

599,806. METHOD OF AND MEANS FOR CONTROLLING ELECTRIC MOTORS; S. H. Short, Cleveland, Ohio. App. filed Oct. 21, 1897. The method of controlling motors which consists in varying the relative connections of two or more motors to maintain a substantially uniform accelerating current, and thereafter reducing the current to a point such as to maintain a uniform speed.

599,807. PNEUMATIC CONTROLLING MECHANISM FOR ELECTRIC RAILWAY CARS; S. H. Short, Cleveland, Ohio. App. filed Nov. 13, 1897. In a system of controlling motors in a train of cars a controller for each car, fluid pressure mechanism for simultaneously actuating said controllers, and means mounted on each car of the train for controlling said fluid pressure mechanism.

599,810. ALTERNATING CURRENT MOTOR; W. Stanley, Pittsfield, Mass. App. filed May 9, 1896. In a multiphase motor, an inducing member provided with a set of contiguous polar faces of one magnetic phase, and a set of polar faces of a different magnetic phase, presented to the induced member so that the resulting fluxes are complanar, each of said sets containing poles of opposite signs.

599,815. VARIPOLAR MOTOR OR DYNAMO; H. H. Wait, Chicago, Ill. App. filed Aug. 20, 1896. The method of operating a motor at different speeds, which consists in supplying current to the motor, producing thereby a magnetic field having a definite number of effective poles, subjecting the currents traversing the armature to the influence of the field thus produced, whereby the armature is caused to rotate at a different rate of speed, changing the paths of the currents traversing the armature windings from series to parallel, and subjecting the currents thus traversing the armature to the influence of the magnetic field as before, whereby the rate of rotation of the armature is increased, then increasing the number of effective poles of the field and redirecting the armature currents in new paths in accordance with the changed condition of the field, whereby the armature is caused to rotate at a higher rate of speed.

599,818. ELECTRIC ARC LAMP; E. P. Warner and H. H. Wait, Chicago, Ill. App. filed March 16, 1897. In an electric arc lamp, the combination with the lamp frame of an insulating chimney therefor, from which the lamp may be suspended, and which is rigidly secured to the lamp, and a duct or ducts in said chimney adapted to receive the carbon or feed rod and the conductors leading to the operating mechanism.

599,828. ELECTRIC RAILWAY; W. M. Brown, Johnstown, Pa. App. filed Oct. 7, 1897. The combination with a traveling magnet, energizing coils therefor connected to opposite sides of the main circuit, and a second set of energizing coils therefor, of an independent source of current supply and a switch interposed in a circuit between the independent source of supply and the said second set of energizing coils, and arranged to close whenever the voltage of the main circuit falls below a predetermined figure.

599,867. TELEPHONE TRANSMITTER; J. H. Rogers, Bladensburg, Md. App. filed March 9, 1897. In a telephone transmitter, the combination with a suitable support of a fixed electrode projecting therefrom, a movable electrode mounted upon the fixed electrode, and a sounding board of light, elastic material, such as celluloid, attached to and depending from the movable electrode in a conical or skirt-like form so as to produce an extended surface adapted to receive sound waves from all sides and to convey the motion produced thereby to the movable electrode.

599,868. ELECTRIC CAR TROLLEY; W. H. Russell, Newcastle, Can. App. filed April 18, 1896. The combination with a trolley arm or pole of a base secured to the end of such arm or pole to move laterally relative thereto, a trolley wire contact piece mounted on a frame on such base to move vertically relative thereto, a projection on the frame of such contact pieces, a rod or guard pivoted to the trolley arm or pole at one end of such trolley guard, and at the other end thereof extensibly connected to the projection on the frame of the contact piece, such rod or guard having lateral swells adjacent to the end thereof, which is secured to the projection.

599,880. ELECTRIC ARC LAMP; C. Tepel, Bennett, Pa. App. filed Dec. 31, 1896. An arc lamp provided with an electromagnetic feeding mechanism and a vertically movable slotted tubular holder for the upper carbon, in combination with a mechanical feeding mechanism provided with a slotted tubular holder for the lower carbon, pivoted dogs having heads located within the tubes, a longitudinally adjustable connection between the two feeding mechanisms for effecting a positive differential feed, whereby the arc is maintained at the one point.

599,881. MAGNETIC CLOSER; J. N. Thomas, Johnstown, Pa. App. filed Oct. 19, 1897. A magnetic closer having an extended pole adapted to supply a substantially continuous magnetic field throughout its length, and composed of a plurality of sections insulated from each other.

599,891. ELECTRIC CONTACT DEVICE; J. L. Buchanan, Johnstown, Pa. App. filed Feb. 4, 1897. In an electric trolley device, the combination of a frame and a plurality of laterally movable rollers carried thereby, and having flanges extending completely over the conductor.

599,892. ELECTRIC REGULATOR FOR DYNAMOS; W. H. Chapman, Portland, Me. App. filed Feb. 10, 1897. The combination of a solenoid having a movable iron core, and composed of four distinct coils of wire arranged to oppose each other and to balance each other's magnetic and mechanical action on said core and to thereby neutralize each other's effect whenever an even number of them is in action, and to pull the said core one way or the other when an odd number of them is in action, a set of electrical contacts arranged to open and close the electrical circuit through one of said coils, and so unbalance the opposing forces and thereby to cause the movement of the core, and a rheostat whose arm is arranged to be operated by the movement of said core.

599,910. INCANDESCENT ELECTRIC LAMP; J. T. Lister, Cleveland, Ohio. App. filed Oct. 2, 1897. In an incandescent lamp, the combination with a bulb provided with two filaments and two pairs of terminals, the said filaments being placed side by side, of a base and circularly shaped spring contacts therein, one of said contacts being shorter than the other, whereby the shorter contact will engage only one terminal at a time, and means for rotatably securing the bulb to the base.

599,913. ELECTRIC MOTOR; E. McNerney, Pittsfield, Mass. App. filed May 22, 1897. An electric motor consisting of a suitable frame or support, an electromagnet mounted longitudinally thereon and insulated therefrom, two revoluble rods or rollers, one of which is mounted at each end of said magnet, upwardly directed spring arms, connected with each of said rods or rollers, and provided with an armature, crank rods connecting with the upper ends of each of said spring arms, and with a crank shaft, said crank shaft being also provided with a compound wheel composed of metal and rubber or other insulating material, and a shaft which passes through one side of the frame or support of the motor, and which is provided with two upwardly directing spring arms, which are adapted to operate in connection with said compound wheel.

599,929. QUICK BREAK SWITCH; H. P. Davis, Pittsburg, Pa. App. filed July 22, 1897. A quick break switch for electric circuits, comprising two stationary jaw terminals and an auxiliary jaw terminal having laterally yielding resilient sides, in combination with a blade provided with a tongue having a head at its free end for engagement with the auxiliary jaw terminal.

599,930. SWITCH FOR ELECTRIC CIRCUITS; H. P. Davis, Pittsburg, and E. F. Harder, Wilkensburg, Pa. App. filed Oct. 28, 1896. A switch for electric circuits, comprising a stationary jaw terminal and a movable blade having spring plates or washers riveted to its sides, the outer side faces of which make contact with said stationary jaw terminal.

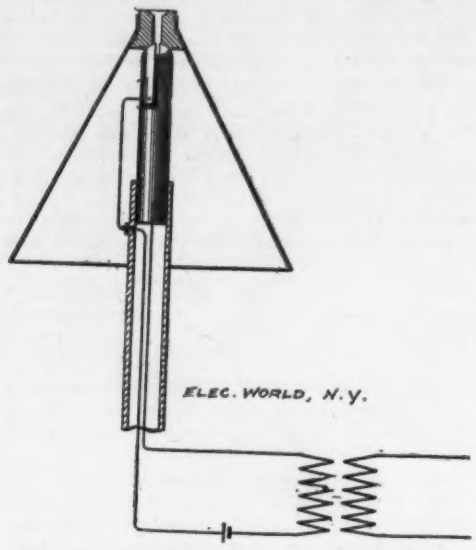
599,931. ELECTRIC ARC LAMP; H. P. Davis, Pittsburg, and F. Conrad, Wilkensburg, Pa. App. filed Aug. 22, 1896. A feeding and brake mechanism for arc lamps, comprising a supporting frame, a feed wheel and chain, a brake wheel geared to said feed wheel, a pivoted brake lever connected at its respective ends to a dash pot and a solenoid core, and provided with a transverse slot, a brake releasing lever pivoted to said brake lever, and having a pin at one end located in said slot, a strap partially surrounding side brake wheel and connecting one arm of said brake lever with one arm of said brake releasing lever, and means for pressing the latter against a stop on the supporting frame.

599,932. METHOD OF AND APPARATUS FOR REGULATING ELECTRIC MOTORS; B. Frankenfield and D. C. Jackson, Madison, Wis. App. filed Jan. 28, 1897. The method of varying the speed of a multipolar motor, which consists in weakening and strengthening the magnetomotive force due to the coils exciting one or more of the poles, while leaving the mag-

netomotive force due to the coils exciting one or more of the poles unchanged.

599,940. NON-SYNCHRONOUS ELECTRIC MOTOR; B. G. Lamme, Pittsburg, Pa. App. filed April 30, 1894. A rotary field motor having a primary member provided with a distributed winding located beneath the surface of the core and in proximity to the adjacent surface of the secondary member, the coils of said winding being superposed and severally embracing a peripheral core space, which differs from that obtained by dividing the circumference by the number of poles.

599,941. DIRECT CURRENT ELECTRICAL MACHINE; B. G. Lamme, Pittsburg, Pa. App. filed July 8, 1897. In a direct current generator or motor, a field magnet having inwardly projecting pole pieces provided with relatively narrow magnetic pole shoes, which project laterally from the pole faces and serve to increase the width of the fringe of the magnetic field.

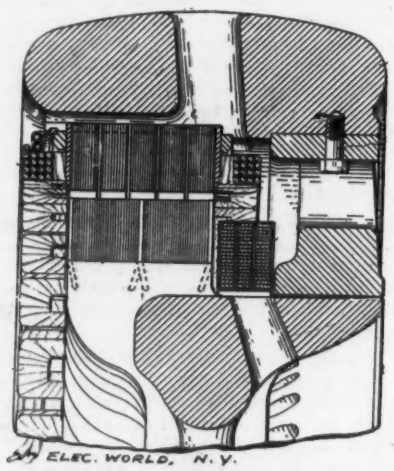


No. 599,867.—Telephone Transmitter.

599,942. INDUCTOR DYNAMO; B. G. Lamme, Pittsburg, Pa. App. filed July 12, 1897. In an inductor dynamo, a magnetizing coil provided with a magnetic circuit having a relatively wide air gap and a relatively narrow air gap in combination with a set of generating coils adjacent to said wide air gap.

599,943. SYSTEM OF ELECTRICAL DISTRIBUTION; B. G. Lamme, Pittsburg, Pa. App. filed Sept. 18, 1897. The combination with a main direct current generator and a work circuit supplied thereby of an auxiliary compound-wound generator having one portion of its field magnet winding in series with its armature and with the main generator, and another portion provided with means for varying its excitation as the load on the work circuit varies.

599,947. ELECTRICALLY PROPELLED VEHICLE; P. R. Salberg, Pittsburg, Pa. App. filed Feb. 5, 1896. In an electrically propelled vehicle, the



No. 599,942.—Inductor Dynamo.

combination with a trolley and means for pressing the same upwardly against the supply conductor, of mechanism for pulling down the trolley when it leaves the conductor, said mechanism comprising a cylinder, a piston, a cord between said piston and the trolley, a controlling valve and a cord between said valve and the trolley, whereby an upward movement of the trolley above the conductor actuates said valve to admit compressed air into said cylinder.

599,954. SWITCH FOR ELECTRIC CIRCUITS; G. Wright, Wilkinsburg, Pa. App. filed Sept. 18, 1897. A double throw switch comprising stationary socket terminals, co-operating plungers and a pivoted operating lever having arms provided with cams for engaging and actuating said plungers alternately in opposite directions.

599,975. PORTABLE ELECTRIC LAMP; L. Paget, New York, N. Y. App. filed July 8, 1897. An electric lamp consisting of a case comprising two parts of conducting material insulated from each other and covered with external insulation, a lamp supported upon the case, and electrically connected thereto, and a battery within the case one of its terminals being in engagement with one part of the case, and the other adapted to be connected with the other part thereof by means of a movable circuit closer.

600,009. THIRD RAIL; L. M. Maxham, Boston, Mass. App. filed June 7, 1897. In a third rail, the combination of a resilient, substantially flat, electro-conductive plate, supports for the edges thereof, a sheet of insulating material having its edges subjacent to those of said electro-conductive plate, means for securing said edges of plate and sheet together, and an electro-conductor located between said plate and sheet, and close beneath the centre line of said plate.

600,051. CENTRIFUGAL RESISTANCE CONTROLLING DEVICE; G. H. Whittingham, Baltimore, Md. App. filed July 29, 1897. In a rheostat, the combination of a revoluble head; a resistance mounted on the head; a switch arm engaging the resistance. and a centrifugally operated lever, mounted on the revoluble head and connected with the switch arm, whereby centrifugal force is utilized to gradually reduce the resistance when the current is turned on.

600,058. FLEXIBLE ELECTRIC CONDUCTOR; A. Bournonville, Philadelphia, Pa. App. filed Nov. 20, 1897. A flexible electric conducting cord having a single central section and two or more terminal sections at one end, a fabric covering for said cord extending continuously over the single section and the terminal sections.

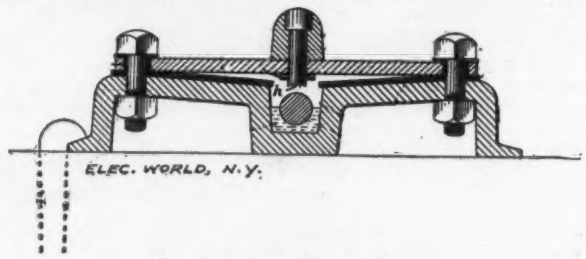
600,063. STRAIN INSULATOR; H. Carmichael, Malden, Mass. App. filed June 13, 1895. A strain insulator composed of interlocking members, one of which is provided with a head and the other of which is provided with a threaded opening, a threaded rod inserted through the said threaded opening, a layer of insulating material interposed between said interlocking members, a second layer of insulating material interposed between the threaded rod and the said head, the said threaded rod being adapted to place the layers of insulating material under strain previous to their being enveloped with the insulating material, and a mass of insulating material enveloping said members and layers and compressible at the temperature and tension of use.

600,073. TELEGRAPH CABLE; J. J. Hall, Slough, England. App. filed Oct. 4, 1897. An electric telegraph cable composed of a plurality of conductors each provided with a wrapping of a netted textile fabric secured thereon by a spirally wound textile thread or yarn, the said conductors being laid in a bunch in the form of a cable, and a textile cord wound spirally around the whole.

600,088. CURRENT COLLECTOR FOR DYNAMO ELECTRIC MACHINES; G. W. Nell, Philadelphia, Pa. App. filed Feb. 23, 1897. In a current collector for dynamo electric machines, the combination of the armature coils, current distributers, one or more magnets located above the collector, levers rotating with the armature and controlled by said magnet or magnets, and contact devices operated by said levers, whereby the connection of the opposite ends of the armature coils with the current distributers will be effected at the proper time, and both connections will be made at the top of the collector.

600,092. ELECTRICALLY OPERATED HOISTING MACHINERY; A. J. Shaw, Muskegon, Mich. App. filed Jan. 16, 1894. The combination with a trolley and with a hoisting beam, tongs carried by said beam, motor for actuating said tongs, insulated conductors extending lengthwise of the beam and connecting with the motor, brushes or contact pieces carried by the trolley and arranged to maintain contact with the beam under carrying adjustments of the latter, and a switch also carried by the trolley and serving to control the supply of current to said motor.

600,101. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; D. Urquhart and F. Wynne, London, England. App. filed Feb. 25, 1897. In apparatus for supplying electricity to electrically propelled vehicles, the combination with road contacts, a main conductor, and switches for successively connecting said road contacts to said main conductor, of condensers, switch operating electromagnetic devices having their windings arranged in the condenser circuits, and an alternator adapted as a vehicle to be propelled



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travels along to have its circuit completed through the successive condenser circuits so as to thereby close the corresponding switches.

600,112. ELECTRIC SWITCH; J. J. Flint, Denver, Col. App. filed Feb. 16, 1897. In an electrical switch, the combination with an insulating base, a cap plate and push buttons, of a lever-like circuit closing arm adapted to be actuated by the push buttons, a support attached to the base and upon which said arm is fulcrumed, a roller attached to one extremity of said arm, a keeper also pivoted on said support and located adjacent hte roller extremity of the arm, said keeper carrying a roller adapted to engage the roller of the said arm, a coil spring connecting the keeper with the stationary support, and suitable contacts which the circuit-closing arm is adapted to bridge.